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ABSTRACT

Designed to address the problems and solutions related to waste management, this curriculum guide contains interdisciplinary activities for K-12 students in Washington State schools. Listings of the activities are provided by concept categories (under the themes of revise, reuse, recycle, and recover); by waste management subject area (addressing such topics as composting, consumer awareness, energy, hazardous waste, landfills, litter, and waste reduction), and by discipline areas (specifying activities for 37 discipline areas). Information on each activity includes: (1) title of activity; (2) existing materials to use; (3) rationale; (4) related subject areas; (5) grade level; (6) learning outcome; (7) materials needed; (8) learning procedure; (9) pre and post questions; (10) sources; (11) bibliography; and (12) resources. School recycling program options are offered and facts about solid waste are presented in separate sections in the guide. Also included are a glossary, an eight-page bibliography, listings of representatives from the Department of Ecology School program, resources from the Department of Ecology, and an evaluation form. (ML)

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A-WAY WITH WASTE

A WASTE MANAGEMENT CURRICULUM FOR SCHOOLS

SECOND EDITION

SE047481

WASHINGTON STATE DEPARTMENT OF ECOLOGY
LITTER CONTROL & RECYCLING PROGRAM

WASHINGTON STATE ENVIRONMENTAL EDUCATION, NORTHWEST SECTION
WASHINGTON SUPERINTENDENT OF PUBLIC INSTRUCTION

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For information on the A-Way With Waste curriculum contact:

Jan Lingenfelter
A-Way With Waste
Washington State Department of Ecology
4350 - 150th Avenue, N.E.
Redmond, Washington 98052
(206) 885-1900
SCAN 8-731-1111

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FOREWORD

The Washington State Department of Ecology has responsibility for educating citizens about the intensifying problems and challenges of managing waste in Washington State. This curriculum guide is the centerpiece for resources the A-Way With Waste Program makes available to Washington State Schools.

Historically, the department has assumed a leading role in controlling litter and promoting recycling; local government is now beginning to share in this responsibility. A principal goal of the A-Way With Waste Program is to serve as a focus of cooperation for individuals, organizations, industries, and agencies concerned with environmental quality and the conservation of resources.

Creation of the curriculum was a cooperative effort of the Association of Washington School Principals, the Washington Education Association, Superintendent of Public Instruction's Office, particularly the Washington State Office of Environmental Education, and the Department of Ecology, with funds provided by the Litter Control and Recycling Program. In its first year, "A-Way With Waste" was reviewed by a committee of recycling industry and environmental organization representatives, waste managers, and environmental educators. Teachers and principals from all parts of the state wrote the guide's activities, which were edited, organized, and expanded by the Department of Ecology, using educational materials and information from across the country.

Under a grant from Snohomish County, the materials were then field-tested in a series of ten teacher-training workshops involving approximately 150 Snohomish County teachers. In the years to come, the Washington State Department of Ecology will continue to work toward its goal of increasing recycling and decreasing waste by educating citizens in the use of "A-Way With Waste."

Jan Lengenfelter
School Program Coordinator

Todd Peterson
Editor/Writer

ACKNOWLEDGEMENT

School Program Coordinator: Jan Lingenfelter
Litter Control and Recycling Program
Washington Department of Ecology

Editors/writers: Todd Peterson
Jeannie Summerhays
Lynne Guza

Senior Advisor: Tony Angell
Wa. St. Environmental Education, N.W. Section
Washington Superintendent of Public Instruction

Contributing Educators:

Elementary: Lynne Guza
- Jeb Baldi
- Leslie Getchell
- Trina Hendrickson
- Laurie Lindgren
- Darlene Weller

Second Edition:
- Irene Bach
- Marjorie Ebel
- Cathy Profilet
- Daryl Starkovich

Middle School: Larry Broder
- Todd Peterson
- David Spies
- Gordon Watanabe
- Henry Yonce

Second Edition:
- April Benham
- Laurie Dyker
- Paula Tweten

Senior High School: Dick Dixon
- Claire Dyckman
- Deb Schuldt
- Diana Townsend

Second Edition:
- Mike Harves

- Barbara Schultz
- Scott Stowell

Workshop Facilitators: Roberta Jean Clemons, Claire Dyckman, Mike Harvis, Dwight Morgan, and Jeannie Summerhays

Staff: Don Abbott, Jackie Baker, Muriel Bergerson, Lee Dorigan, Leslie Getchell, Elena Guilfoil, Art Hugo, Dennis Johnson, Bev Poston, Mike Swigert, and Gary Weston.

Technical Assistance: John Conroy, Allen Fitz, Conrad Lee, Julie Sellick

Program Review Committee: Tony Angell, Larry Broder, Anne Bringloe, Doris Cellarius, Sarah Chandler, Jack Crawford, Allen Fitz, John Glynn, John Kramp, Peg Larson, Greg Matheson, Ed Rubatino, Bill Schmidtman, Laura Zalesky

Clerical Support: Meredith Bigelow, Peggy Hamilton, Lynn Porter, Katheryn Suchy, Elaine Windle, Ann Wright, Word Processing - Headquarters, Susan Cooper, Joan Villines, Marilyn Harrison

Research Assistance: Washington Department of Ecology Library, Washington State Library, King County Library System, ERIC Search

Illustrations: Creative Communications: Director, Jane Howard - Illustrator, Kate Allen; Tim Schlender, Washington Department Of Ecology

Layout and Design: Mike Drumright, Terence Todd

Special Thanks to: Alice Adams, James Garner, Sally Hicks, Chris Peterson, Emily Ray, Kathy Seel, Jerry Sussman
Washington State Recycling Association

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INTRODUCTION

This curriculum was written because the old out-of-sight, out-of-mind attitude toward waste won't work anymore. As the population of Washington State continues to grow, so does the amount of waste produced in the state. Currently, a total of almost 3.6 million tons of waste a year is generated in Washington, the equivalent of 4.6 pounds a day for each resident.[1]

The cost of waste disposal also continues to rise. The Washington State Department of Ecology (WDOE), with funds from the Model Litter Control and Recycling Act, spends nearly $687,000 a year on litter pickup alone. (This Ecology Youth Corps litter pickup program is funded by a tax on manufacturers, wholesalers, and retailers of products and packaging related to the litter problem.) In Seattle, in the last five years, the cost of residential and commercial waste disposal has increased 55 percent, or about a million dollars a year;[2] in Snohomish County waste disposal costs have increased fivefold since 1979.[3] Across the state, finding suitable landfill sites is becoming difficult and is already a serious problem in King and Snohomish counties. Landfills are a blight on the landscape and residues, some toxic, may leach into the ground.

In a world of increasingly scarce natural resources and increasingly expensive energy, it is senseless to lose forever in landfills the valuable materials and energy contained in waste.

So how can this curriculum help teachers work toward solving the environmental and economic problems caused by waste?

First, these materials are designed to give students the sense that waste is a problem they can help solve.

It gives teachers the means to present a real issue facing the community and shows students simple and practical ways to reduce their own waste, thereby doing something socially beneficial.

The interdisciplinary activities range from dealing with everyday household situations, such as changing your buying habits in order to reduce what you throw out, to complex global issues, such as resource depletion.

Options for school recycling programs are included. These programs can teach students business management, raise money for school projects, involve parents in school activities, and reinforce the school's role as a community center.

Sources:

[1] Washington Department of Ecology. Solid Waste Division, 1980.

[2] City of Seattle, Engineering Department, Solid Waste Utility, 1983.

[3] Solid Waste Division, Public Works Department, Snohomish County, WA., 1983.

This curriculum can help teachers meet their traditional responsibility to prepare students for the future. The high cost of waste disposal, degradation of the environment by landfills, resource depletion - - these specific elements of the larger problem of waste -- will all have to be dealt with by students when they become adults. But the future severity of these problems will be determined now by how well students are taught that individual understanding and responsible action are the first answer to the problem of waste.

"A-way With Waste" is organized around four concepts of waste management. These are:

Revise

Revise is the most comprehensive category of this curriculum. This section encourages students to revise their awareness and attitude about what they throw away. The activities encourage students to become aware of the magnitude of the waste problem in their communities, to become aware of waste as a potential health and safety hazard, and to become sensitive to waste, in the form of litter, as not only ugly but also dangerous to wildlife. In addition, this section of the curriculum contains activities dealing with hazardous waste.

The Revise section encourages students to revise the way they see waste, seeing it not as junk without further use, but as a repository of conservable and reusable energy and natural resources.

Students are asked to examine and revise their buying habits with the aim of reducing the amount of what they buy that ends up being thrown away.

After reducing their wastes to a minimum, students are shown ways to change their waste disposal habits through recycling and reusing.

All of this results in the most important purpose of this section: to encourage students to revise their sense of personal responsibility toward the waste problem. By doing this, they avoid further contribution to the problem and become part of its solution.

Reuse

The activities in the Reuse section, as do those in the Revise section, promote the conservation of natural resources and the reduction of waste. Students will learn that things do not have to be reprocessed and recycled in order to be used again. Students are shown ways to reuse what they own so they can reduce what they throw away.

Recycle

The recycling activities teach students how recycling conserves energy and natural resources. They will learn what is recyclable, some of what happens during the recycling process, and why recycling can be profitable. Students and teachers are shown ways to recycle at home and in school.

Recover

Resource recovery is the use of high technology to burn mixed solid waste to generate electricity or industrial fuel. Although some resource recovery technology is designed to separate the recyclables before burning, reuse and separation are done much more efficiently and cheaply by the individual at home before all kinds of refuse are dumped together and hauled away. The enormous size, however, of the waste problem in some areas will likely necessitate an increasing reliance on resource recovery facilities. Inasmuch as resource recovery plants produce energy, may reclaim recyclables and reduce the volume of waste going into landfills, they are attractive waste management options. They are less attractive in that they are enormously expensive to build. By requiring a steady, high-volume flow of waste, they may discourage recycling, they may contribute to air pollution, and they may reinforce us in our habitual abdication of individual responsibility for the proper disposal of our waste.

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Can We Do Without the Can?	K-12	43
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The Throwaway Three	4-6	79
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REVISE

WHAT IS GARBAGE
?

TITLE: BE A GARBAGE DETECTIVE

USE WITH: (Re)Show and (Re)Tell, p. 195, Litter, Litter Everywhere, p. 45, Take a Look in Your Garbage Can!, p. 234.

RATIONALE: All living creatures produce some sort of waste and have devised ways to deal with it. We humans are very wasteful creatures compared to our fellow earth inhabitants and often are not concerned about what happens to our waste.

SUBJECT: Art, Science, Language Arts

GRADES: K-1

LEARNING OUTCOME: Students will define waste (what we often call garbage) and become aware of what happens to it after it is put in the trash can.

LEARNING PROCEDURE:

1. Ask each student to draw two pictures. One picture should be of his/her house. The other should be of a deer's, bear's, or snake's "house." Ask students to look at their pictures and think about garbage. What is garbage? Do animals have to deal with garbage? Why do people have so much more garbage than animals? How do people get rid of garbage? Where does it go? What happens to it after it gets to the landfill?

2. Working together, with the teacher taking dictation and writing on the chalk board, have the class create a story describing the pictures they have drawn.

3. Have the children go through magazines and find pictures of things that often get thrown away after only one use. Have the children create a poster from these pictures. Ask: How could we avoid throwing away so many of these things?

4. Display drawings, the class story, and poster.

PRE & POST TEST QUESTIONS:

What is garbage?

Where does it come from?

Why do people create more waste than other animals?

BIBLIOGRAPHY: Gabel, Margaret. Sparrows Don't Drop Candy Wrappers. New York, N.Y.: Dodd, Mead, 1971.

Cox, Victoria and Stan Applebaum. Nature's Assistant. New York, N.Y.: Golden Press, 1974.

Garner, James, Ed. Project L.I.F.E. Learning in Familiar Environments: Schoolyard Activities and Learning Games to Supplement the Elementary School Curriculum. Washington State: Conservation Commission, 1981.

Stone, Harris. The Last Free Bird. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1967.

RESOURCES: Available from the Department of Ecology. To order see page 343.

Life Before Litter. Ohio Department of Natural Resources, Office of Litter Control, Filmstrip/tape, 8 min., color, K-3.

HONEY
KITTY YUMS

TITLE: LITTER IS WASTE OUT OF PLACE

USE WITH: Litter, Litter, Everywhere, p. 45, Would You Do It If I Taught You? If I Paid You?, p. 72, Nurture Some Nature, p. 52, and Out of Sight, But Not Out of Mind, p. 70.

RATIONALE: Litter is waste material that escaped from the waste handling system. Litter is manmade or man-used materials.

There are seven main places in our community where waste materials are most apt to escape:

1. Home garbage cans
2. Business and commercial garbage cans and dumpsters
3. Trucks with loads improperly tied down or covered
4. Construction or demolition sites
5. Loading docks and commercial storage areas
6. Material thrown, dropped, or blown from cars
7. Materials thrown or dropped by pedestrians

Most people think of litter as coming from motorists and pedestrians. Many people are too quick to blame children and young adults for all litter problems, but the problem can come from many places in our community.

SUBJECT: Social Studies, Science, Math

GRADES: K-5

LEARNING OUTCOME Students will pick up litter and discuss what it is, why it is where it is, where it comes from, and suggest some methods to control it.

LEARNING PROCEDURE:

1. Call the WDOE Regional Office nearest you (see page 343) and ask for the colored poster "The Seven Sources Of Litter" and enough coloring posters for your students.

2. Discuss where litter comes from using "The Seven Sources Of Litter" poster. Ask: What is litter? Why is there litter? Where might you find litter? How can you and your family help prevent litter?

3. Bring in examples of different types of litter, identifying the location where the litter was found.

4. Have the children save their lunch sacks or bring a grocery sack from home. Take the children for a walk around the playground and the neighborhood, picking up human-made litter. Teacher -- record items and where they were found. On returning to the classroom, have the children empty their trash collections onto pieces of newspaper. Have

each child talk about where each piece was found. Ask: What might have caused litter in that place? Why? How? Make a list of responses on the chalkboard. Have the children categorize the litter according to types of material and discuss whether it can be reused or recycled.

5. Have the children make a list of who, besides themselves, can prevent litter in their neighborhood and school. Students may want to make a map of the neighborhood, including the school grounds, indicating where the litter receptacles are located. After discussion, the children could indicate on their maps where they think litter receptacles should be located.

6. Many communities are recognizing the sources of litter and developing program and educational material to teach people how to keep waste materials from escaping and becoming litter.

    - Home garbage - Use only trash containers with tight fitting lids. Paper or plastic bags can be opened by animals. Trash cans without lids or with loose lids can be knocked over by animals and the wind can move the trash several blocks, or even miles.

    - Business trash - Tight, closed lids and even locks are sometimes needed.

    - Truck loads - If loads are not tied down, many dangerous materials fall or are blown from the truck. Air pressures increase as trucks drive faster. Loose material is blown out of truck beds. Many people don't think about putting on tarps and some don't know that they are accidentally losing parts of their load. Roads to the dumps are easy to follow because of all the litter along the roadway.

    - Construction and demolition sites - Fences around construction sites keep materials from flowing out into the neighborhood. Putting waste materials into proper containers and tarping truck loads keep construction sites clean and construction and demolition materials off our roads.

    - Loading docks - Keeping storage bins or dumpster tops closed and the area clean keep this material in place and away from the rest of the neighborhood.

    - Motorists - Car litter bags and litter containers at rest areas, gas stations, and fast foods stores are both important to controlling auto littering.

- Pedestrians - Sidewalk litter receptacles and good habits help control this source of litter.

With all of the above sources of litter, the two most important things are: (1) People knowing that they can be part of the problem or part of the solution, (2) People caring for their community.

Ask: How can we prevent litter at school and in our community? Teacher read article "My Twenty Foot Swath" p. 138.

PRE & POST
TEST QUESTIONS:

What is litter?

Who causes litter? How and Where Do Waste Materials Escape to Become Litter?

Where might you find litter?

How can litter be prevented?

BIBLIOGRAPHY:

"Adventures In Environment" Teachers Resource Book Need, National Park Foundation, Silver Burdett Co., 1975

Syrek, Daniel B. Washington Litter, 1983, Institute for Applied Research, Sacramento, California.

California Waste Management Board. Clean. California Litter Education and Action Network. 1020 Ninth Street, Suite 300. Sacramento, California 95014.

Ohio Department of Natural Resources. Ohio Litter Control Program 1984 Annual Report. Fountain Square. Columbus, Ohio 43224.

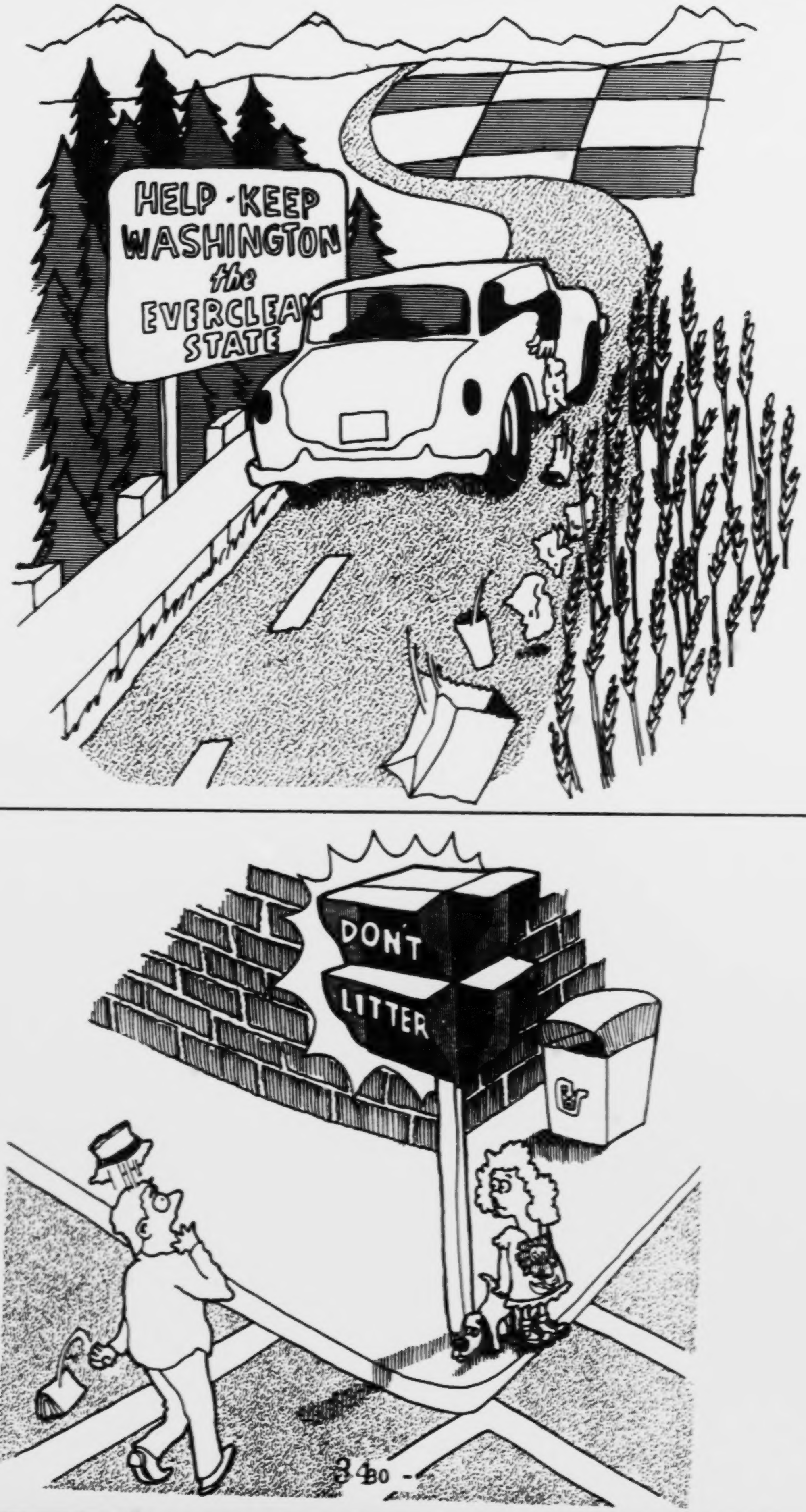
RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Poster - "The Seven Sources of Litter"

Garbage, "Educational Media", 1969, 10 min. Color.

The Litterbug Walt Disney Productions, 1955, 10 min. Color.

Wizard Of Waste California Solid Waste Management Board, 1980, 12 min. Color.


HELP - KEEP
WASHINGTON
the
EVERCLEAN
STATE
DON'T
LITTER

TWO OF THE SEVEN SOURCES OF LITTER

TITLE: NOWHERE IS AWAY OR WHERE IS THERE SPACE FOR WASTE?

RATIONALE: Enlarging awareness of the solid waste problem will lead to changes in buying and waste disposal habits.

SUBJECT: Social Studies, Math

GRADES: K-3

LEARNING OUTCOME: Students will learn what each can do to help solve the problem of too much solid waste.

MATERIALS: 4½-pound bag of trash
Pictures and articles about the solid waste problem (see Bibliography and Resources)

LEARNING PROCEDURE:

1. Bring to class a 4½-pound bag of garbage, or bring in a school garbage can.

2. Emphasize that on the average, each person in Washington State discards about 4½ pounds of waste a day.

3. Using these figures, how many tons of garbage would this class generate in a year? To gain a clearer understanding of the magnitude of a ton, have students add the weights of class members until a ton is reached. ("Annually we each average more than a ton of household and industrial waste - enough from Seattle alone to fill the Kingdome three times."[1])

4. Ask: Where does all this waste go?
   What problems does it create?

5. Add to student answers the information that, nationally, most waste goes into 15,000 landfills occupying 476,000 acres.[2] (One acre is about 1½ times the size of a football field. Calculate: How many football fields are covered with trash?) Emphasize that at the increasing rate at which we are throwing away trash, we need approximately 500 new dumping locations every year. Other problems associated with this growing mountain of trash are:

   - Finding sites for landfills is becoming increasingly difficult.
   - Runoff and leachate from landfills pollute surface and ground water.
   - Disposing of waste is very expensive (about $4 billion a year is paid by Americans to dispose of trash.)[3]

6. To illustrate these points, use pictures from the Ranger Rick Article, "The Mess We're In," and the film, "Garbage," available from WDOE.

7. Ask: What can you and I do to help solve this problem?

   Brainstorm possible solutions. Emphasize that one important solution is to generate less waste.

   Discuss what kinds of waste students generate and discuss ways to reduce it.

8. Emphasize that another solution is to recycle. Using articles from the 4½-pound bag of trash, show which are recyclable.

9. Start a class recycling project. Call 1-800-RECYCLE to identify your local recycler. For help in getting your project started, call the WDOE office nearest you. See p. 343.

10. Next, do the activities, "Take a Look in Your Garbage Can," p. 234, "What is Garbage to You May Be Gorgeous to Me" p. 47, "Research into Recycling" p. 227, and "Take-Home Recycling Kit" p. 229, as preparation for children to source separate at home.

EXTENDED LEARNING

Call or write your local or county sanitation or public works department to find out how much waste is generated in your area and where it is disposed of.

PRE & POST TEST QUESTIONS:

On the average, how much waste does each person in Washington State discard every day?

SOURCES:

[1]Dietrich, Bill. "Garbage: A Burning Issue." Seattle Times/P.I., April 8, 1984.

[2]&[3]White, Peter T. "The Fascinating World of Trash" and Denis Hayes. "Repairs, Reuse, Recycling." World Watch Paper 23. (Full citations in bibliography)

BIBLIOGRAPHY:

Edmund, Sean. "The Mess We're In," *Ranger Rick*, July 1970. Vol. 4, No. 6, pp. 4-10.

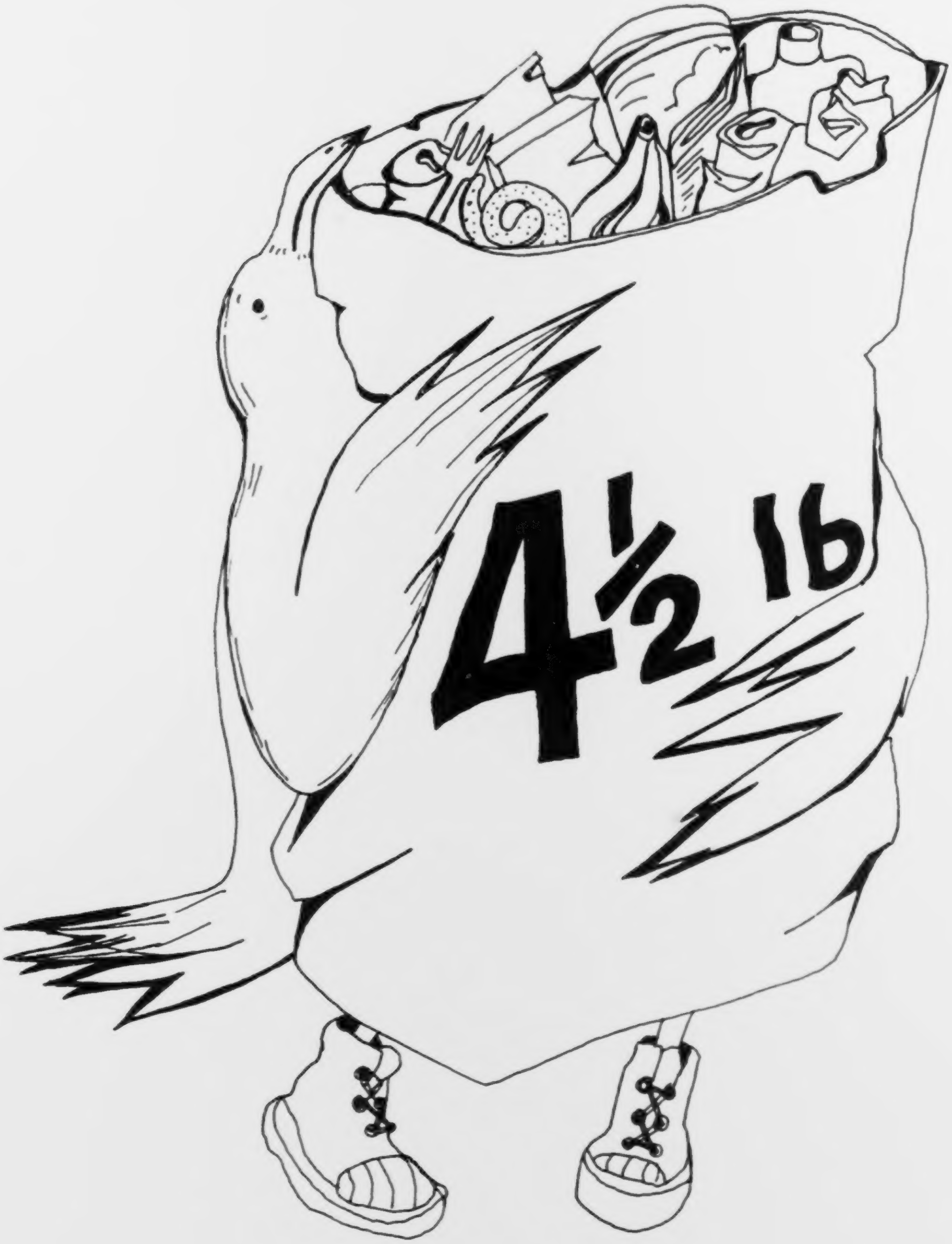
RESOURCES:

Available from the Washington Department of Ecology. To order see page 343.

Garbage. Educational Media, 1969, 16 mm, 10 min., color.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

NOWHERE IS AWAY



TITLE: NECESSARY WRAPPERS?

USE WITH: Extra Fancy Duds, p. 41, Ads Add Up, p. 49, and Finders Keepers, p.198.

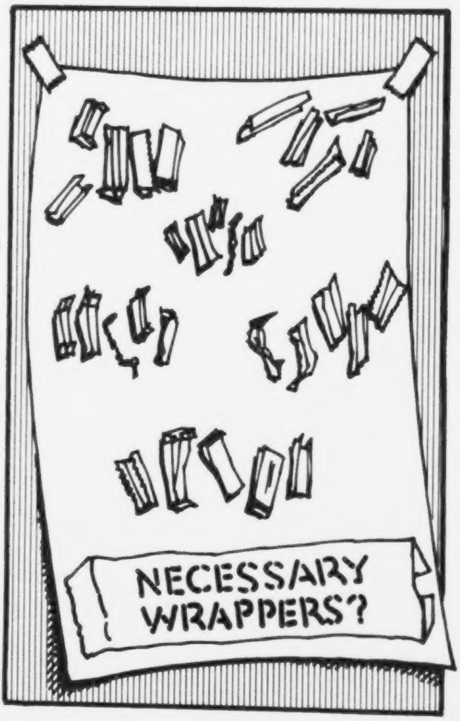
RATIONALE: Approximately 40% of household waste is packaging.[1] Consumers decide what becomes garbage.

SUBJECTS: Science, Math

GRADES: K-5

LEARNING OUTCOME: Students will realize that large amounts of packaging may be used to wrap products they buy.

MATERIALS: Packages of gum


NECESSARY WRAPPERS?

LEARNING PROCEDURE:

1. Divide students into small groups.
2. Using packages of sugarless gum, pass out one stick to each child.
3. Ask each child to carefully unwrap the gum without tearing the wrappers.
4. Have each group create a poster by gluing wrappers on a piece of construction paper in a pattern. Glue wrappers in groups of 5 or 10 so that they can be easily counted.
5. Ask children to guess how many wrappers there are, then count them. Don't forget the outer wrapping and layers of packaging. Ask: If you chewed one pack of gum a week, how many wrappers would you have to deal with in a year?
6. Ask children why there are so many wrappers. Identify the possible purposes of each. Ask: If you were going to package gum how would you do it?

7. Ask children to identify the source of raw materials for packaging; i.e., the plastic, the aluminum foil, the paper, and the gum itself.

8. Ask children to think of other things that their families buy that come in packages.

9. Ask: If we reduce the amount of packaging, will we reduce the amount of garbage?

PRE & POST TEST QUESTIONS:

Where does packaging go if you throw it away?

How can you reduce the amount of packaging in you garbage can?

Name two types of packaging difficult to recycle. Easy to recycle.

SOURCE: [1] White, Peter T. "The Fascinating World of Trash." National Geographic. April 1983. p. 448.

BIBLIOGRAPHY:

National Association of Consumer Agency Administrators. Advertising, Packaging, and Labeling. Washington D.C.: United States Department of Commerce, Office of Consumer Affairs, 1980.

Sullivan, George. How Do They Package It? Philadelphia: Westminster Press, 1976

RESOURCES: Soopergoop. (Churchill Films), 1976. 16mm, 13 minutes, Color.

TITLE: MAKING A MINI LANDFILL

USE WITH: Litter, Litter Everywhere, p. 45, and Compost - The End and the Beginning, p.257, Nonrenewable Resources, How Long Will They Last?, p. 253.

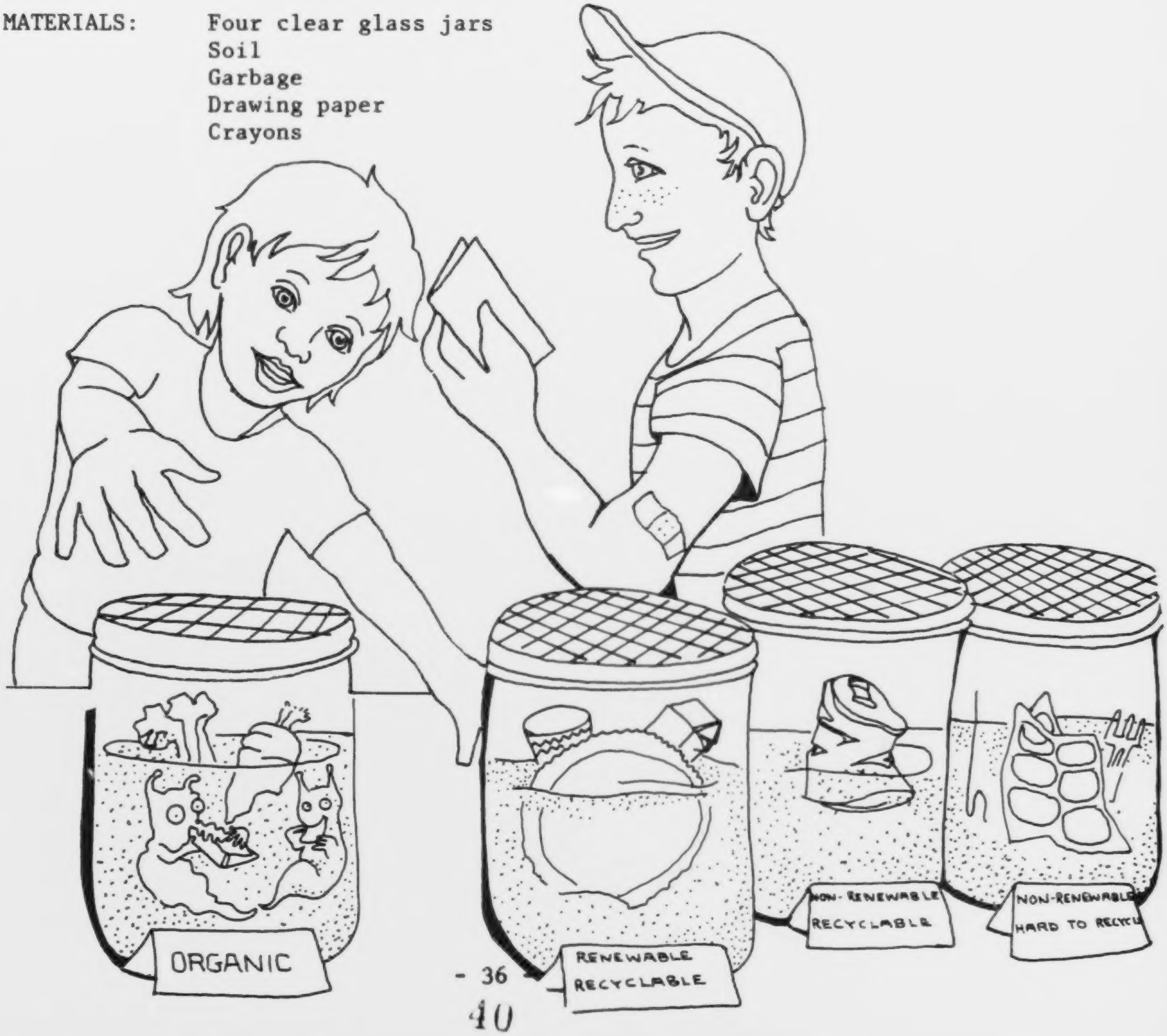
RATIONALE: Products that end up as solid waste are made from a variety of natural resources. Because of differences in composition and biodegradability, much of what we now throw away could be composted or recycled.

SUBJECTS: Science, Social Studies

GRADES: 3-9

LEARNING: OUTCOME: Students will understand some of the energy and resources embodied in solid waste. They will learn the meaning of the terms "organic," "biodegradable," "renewable" and "nonrenewable resource" and why each kind of solid waste needs to be handled in a particular way.

MATERIALS:
Four clear glass jars
Soil
Garbage
Drawing paper
Crayons


ORGANIC
RENEWABLE RECYCLABLE
NON-RENEWABLE RECYCLABLE
NON-RENEWABLE HARD TO RECYC

LEARNING:
PROCEDURE:

Step A. 1. Ask students how garbage is disposed of. Discuss: The proper disposal method for each component of garbage should be determined by its natural resource content.

2. Outline for students these four basic categories of solid waste:

   a. Organic (e.g., potato peelings)
   b. Renewable resource/recyclable (e.g., newspaper)
   c. Nonrenewable resource/recyclable (e.g., aluminum cans)
   d. Nonrenewable resource/hard to recycle (e.g., plastic milk jug)

3. Have each student choose an item that ends up as garbage. Have students draw the lifecycle of this item from raw material to disposal in a landfill.

4. To save natural resources and to reduce solid waste, which of these four categories would you try to buy products from? Which category of products would you avoid? Taking each of the examples listed (potato peelings, newspaper, aluminum can, plastic milk jug) think of ways to avoid disposing of them in a landfill.

Step B. 1. At the grocery store, while purchasing the family's groceries, have each student keep a record of the purchases by dividing them into the four solid waste categories.

2. In class, have students discuss which items they should eliminate from their shopping list or how they can substitute the nonrenewable/nonrecyclable items with items that use renewable resources and generate less trash for the landfill.

Step C. 1. Fill four glass jars with the same amount of soil.

2. Label each jar with one of the four category headings.

   a. Organic
   b. Renewable/recyclable
   c. Nonrenewable/recyclable
   d. Nonrenewable/hard to recycle

3. Put an appropriate small sample in each jar. Cover with soil and dampen with water. Leave the lids off.

4. Observe what happens over two to three weeks. Discuss the condition of the various kinds of waste. Discuss biodegradability. Compare the mini landfill to real landfills. From your observations, discuss the environmental problems associated with waste in landfills (leachate contamination of water, smell, methane gas, garbage truck traffic, litter, scavenging birds, scarcity of landfill sites, cost, loss of natural resources and energy, etc.).

CHART FOR "MAKING A MINI-LANDFILL"

---EXAMPLE---

Product	Chart for "Making a Mini-landfill" Step b. What type of resources were used for the packaging?				Is this product necessary? Is there an alternative?		How could this product be better packaged to save resources and energy?
	Organic	Renewable-Recyclable	Non-renew-Recyclable	Non-renew.-Nonrecyclable			
Plastic milk jug				x	Yes	Yes	In glass or waxed cardboard
Chewing gum		Part	Part	Part	No	Yes	Package in biodegradable paper
Vegetable in tinned can			Where a market exists		Yes	Yes	Can the vegetables yourself in reusable jars. Biodegradable paper package for frozen foods
Pop Aluminum can			x		No	Yes	glass, also returnable glass

CHART FOR "MAKING A MINI-LANDFILL"

Product	Chart for "Making a Mini-landfill" Step b. What type of resources were used for the packaging?				Is this product necessary? Is there an alternative?		How could this product be better packaged to save resources and energy?
	Organic	Renewable-Recyclable	Non-renew-Recyclable	Non-renew.-Nonrecyclable			

EXTENDED LEARNING: Take a field trip to your county's landfill or invite your county's solid waste manager to speak to the class.

PRE & POST TEST QUESTIONS:

What does "biodegradable" mean?

What is the difference between a dump and a sanitary landfill?

Which natural resources are renewable? Which are not? Why?

What are four items you use everyday you could recycle?

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Clapp, Leallyn B. and George Martin, "Solid Waste as Resource." Science Teacher. March 1974, Vol. 41, No. 3, PP. 30-32.

Savas, E. S., The Organization and Efficiency of Solid Waste Collection. Lexington, Mass.: Lexington Books, 1977.

Dart, R. K. Microbiological Aspects of Pollution Control. Amsterdam, New York: Elsevier Scientific Publishing Co., 1980.

RESOURCES: Available from the Washington Department of Ecology. To order see page 343.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE: EXTRA FANCY DUDS

USE WITH: Necessary Wrappers?, p.34, Putting Your Product in a Package, p. 107, and Not In My Shopping Cart, p.89.

RATIONALE: Packaging influences what people buy. People have choices and can reduce the amount of garbage (solid waste) they generate by making thoughtful choices when they buy packaged products.

SUBJECT: Math, Science, Social Studies

GRADES: K-5

LEARNING OUTCOME: Students will be able to identify types of packaging and the ways that they are influenced to buy products that are overpackaged.

MATERIALS:
Two Apples
Ribbon

LEARNING PROCEDURE:

1. Ask Children to bring samples of:

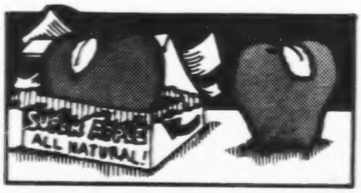
   a. "Nature's Packaging" (Coconuts, bananas, peanuts, nuts, oranges, etc.);

   b. Packaging that could be reused or would biodegrade if discarded: returnable bottles, waxed paper, waxed paper milk cartons, pottery; (In early times most packaging was of this type: pottery jugs, woven baskets, animal skins, etc.)

c. Excessive or difficult-to-recycle packaging; (plastics, styrofoam, plastic milk jugs, individually wrapped packets, laminated packaging, etc.)

As a class or in small groups, sort items into three categories. Discuss what the packages are made of, where they came from (i.e., trees, oil, bees (some waxes), etc.)

2. Bring two apples to class and a fancy bow. Show the apples to the children, placing the bow on one of them. Ask them which one they would like to buy. What made them want one apple over the other? How do people package things (products) so that it makes you want to buy them?



PRE & POST
TEST QUESTIONS:

What does "biodegradable" mean? (See Glossary)

What functions are served by product packaging?

What is plastic made of?

After you open a package and empty it, where does it go?

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Environmental Action Coalition. It's Your Environment: Things to Think About - Things to Do. New York: Charles Scribner's Sons, 1976.

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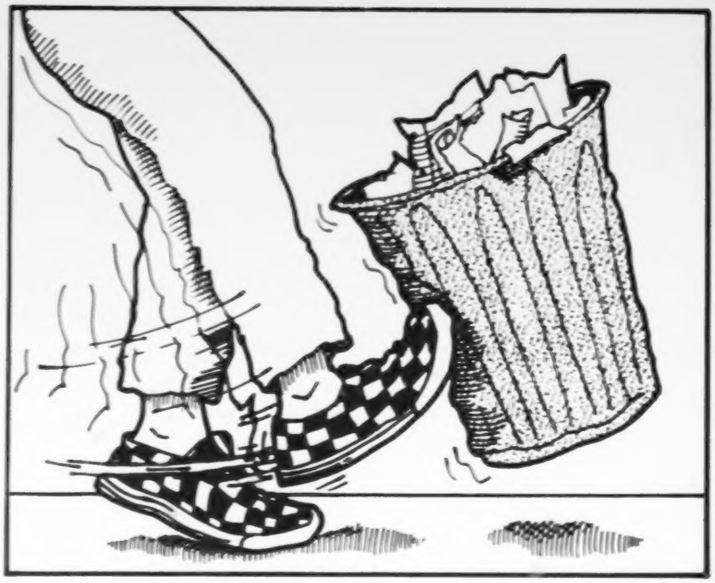
RESOURCES: Soopergoop. Churchill Films, 1976. 16mm, 13 minutes, Color.



TITLE: CAN WE DO WITHOUT THE CAN?

USE WITH: Wise Use Of Paper, p.201, Making Recycled Paper, p. 217.

RATIONALE: Awareness of the large volumes of paper a class throws away and informed decision making can significantly reduce a class's paper waste.

SUBJECT: All Subjects

GRADES: K-12

LEARNING: OUTCOME: Students will reduce the amount of paper they throw away.

LEARNING PROCEDURE:

1. Place the following chart on a bulletin board or wall near the waste basket(s) at a height easily accessible to students.

2. Ask students to write their initials and what they discarded in the appropriate space every time they throw something away. Do not discourage students from using the waste basket(s).

3. At the end of a week, have students form small groups and respond to the following, drawing a bar graph from the results.

   a. What types of things were thrown away?
   b. Approximately what percentage of what was thrown out was reusable paper?
   c. What additional uses could have been found for this paper?

4. Have students working in groups draw large butcher paper graphs plotting days on the horizontal axis and number of visits to the waste basket on a vertical axis.

5. Have groups compare their lists of composition, estimated percentages, and alternate uses for discards.

6. At the end of the week, conduct the activities -- Wise Use of Paper, p. 201, and Would You Do It If I Taught You? If I Paid You?, p. 72.

7. After completing Wise Use of Paper and Would You Do It If I Taught You? If I Paid You?, put up a new chart near the waste basket and repeat the activity.

8. Discuss and compare the results as reflected on the bar graphs. Emphasize the effect awareness and informed decision making can have on reuse of paper and on "doing without the can."

EXTENDED LEARNING: With the cooperation of the custodian, remove the waste basket entirely for a week. Stipulate that no waste be disposed of outside of the classroom. Point out that many counties and cities across the United States are faced with this situation of producing waste but having few choices about where to put it.

As the end of the week weigh the amount of accumulated refuse to come up with a per day and per person average.

Separate materials and recycle.

Discuss ways to reduce the volume of waste the class produces.

PRE & POST TEST QUESTIONS:

How can we reduce the amount of paper we throw away?

	John	Sarah	George	Martha	Fay	ETC.									
Monday															
Tuesday															
Wednesday															
Thursday															
Friday															

TITLE: LITTER, LITTER EVERYWHERE

USE WITH: Nurture Some Nature, p 52, Plastic Trash and Wildlife, p 58.

RATIONALE: Litter is a mixture of organic and inorganic material. Each type of litter should be disposed of in a different way.

SUBJECT: Science, Social studies

GRADES: K-3

LEARNING: OUTCOME: Students will define the word "litter" and explain what happens to it.

TEACHER BACKGROUND: Littering is illegal in Washington State. Persons convicted of littering are subject to a minimum fine of $50 and/or litter pickup time. Litter bags are required by law in all vehicles and boats. It is illegal for a vehicle to be driven in this state with materials that are loose or falling off. Persons not complying with this law are subject to a flat fine of $108. Call 1-800-LITTERS (toll free) to receive a complimentary litter bag or to report motorists you observe littering. Report license number;: make and model of vehicle; and the location, date, and time of the incident.

MATERIALS:
Two jars with lids
Soil

LEARNING PROCEDURE:

1. Bring in several examples of litter and determine if they are from nature or from people. Using the litter, define organic and inorganic matter. (For definitions, see the glossary at the end of the guide.) Make certain the children understand the difference between the two types of matter and how they comprise litter. Discuss what happens over time to nature's litter and what happens over time to the litter people generate.

2. Take the class for a short walk around the school or neighborhood to collect people litter and nature's litter.

3. Hold a short talk on what they found and where.

4. Take two jars and place nature's litter in one and people litter in the other. Combine with soil. Be sure to water each. Observe what happens to the contents of both jars. (Make sure lids are off the jars.) Also, see Making a Mini Landfill, p. 36.

Ask: What is the best thing to do with each type of litter?

PRE & POST
TEST QUESTIONS:

What is litter?

What does "organic" mean?

What does "inorganic" mean?

Name three things that are inorganic.

BIBLIOGRAPHY:

Keep America Beautiful, Inc. Waste in Place. New York, N.Y.: Keep America Beautiful, Inc., 1979.

Shuttlesworth, Dorothy E. Litter - The Ugly Enemy: An Ecology Story. Garden City, N.Y.: Doubleday, 1972.

Smaridge, Norah. Litterbugs Come in Every Size. Racine, Wisconsin: Western Publishing Co., 1972.

RESOURCES:

Film: The Neatos and the Litterbugs in the Mystery of the Missing Ticket. Racine, Wisconsin: Sandles Institutional Films, 1974. 16 mm, 6 minutes, color.

Available from the Washington State Department of Ecology. To order see page 343.

1. Litterbags
2. The Litterbug. Walt Disney Productions, 1955. 16 mm, 10 minutes, color.
3. PSA's. Washington State Department of Ecology. Public service announcements, VHS ½" tape, 3 min., color.

TITLE: WHAT IS GARBAGE TO YOU MAY BE GORGEOUS TO ME (Follow-up activity for Nowhere is Away or Where is There Space for Waste?, p. 31.)

RATIONALE: Space for landfills is at a premium and getting harder to find, while the natural resources in solid waste grow scarcer and more expensive.

SUBJECT: Social Studies, Creative Thinking, Language Arts

GRADES: K-6

LEARNING OUTCOME: Students will understand that one good answer to the problem of solid waste is to extend the life of what they own by finding new uses for it.

LEARNING PROCEDURE:

1. Using the same 4½-pound bag of garbage as in Nowhere is Away. . ., ask students for help in thinking of ways that the various articles and materials could be used again.

2. As each article is handled, discuss the difficulties of its disposal. For example, ask, "What happens to this plastic milk jug or wrapper or glass jar or stale bread when it is "thrown away"; when it is buried; when it is burned? What problems are caused by burying and burning these things?"

3. As each article is handled, discuss how we might either avoid buying it in the first place or buy something comparable that would be easier to recycle, reuse, or compost.

4. Have each student bring from home an article of "garbage" with potential for reuse. Have each explain, either orally or in writing, how each article could be reused.

5. Make a class booklet of the best ideas. Make copies of the booklet to be included in the activity, Take-Home Recycling Kit.

6. Write to Wilton Falls, New Hampshire to find out how the town hopes to recycle and compost 80 percent of the town's waste.

PRE & POST
TEST QUESTIONS:

Name three things you have thrown away that could have been reused.

Why is reuse important?

Where does garbage go after it is picked up?

BIBLIOGRAPHY:

Marshall, James. Going to Waste. New York, N.Y.: Coward, McCann and Geoghegan, Inc., 1972.

Miles, Betty. Save the Earth: An Ecology Handbook for Kids. New York, N.Y.: Alfred Knopf, 1974.

Beame, Rona. What Happens to Garbage? New York, N.Y.: Julian Messner, a Division of Simon and Schuster, Inc., 1975.

Silverstein, Shel. "Hector the Collector," "Sarah Cynthia Sylvia Stout Would Not Take the Garbage Out," Where the Sidewalk Ends. New York, N.Y.: Harper and Row, 1974.

TITLE: ADS ADD UP

RATIONALE: Our consumer habits are influenced by television, magazine, and radio advertising. In making consumer decisions, we should use rational thought that takes into account the consequences of our buying choices (including the generation of solid waste).

SUBJECT: Language Arts

GRADES: 2, 3

LEARNING OUTCOME: Students will be able to identify advertising. Students Will be able to identify good and bad aspects of specific advertisements.

LEARNING PROCEDURE:

1. Show a magazine ad or play the tape of a radio or TV ad that would appeal to second and third graders. Show WDOE public service announcement videotapes. To order, see p. 343.
2. Ask: What are the people in this ad doing? Would you like to be one of these people? Why? or Why not? Why was this picture taken or this tape made?

Other Questions:

1. Is it true that if you use this product you will feel like these people? What will using this product do for you? Why are advertisements made? Who makes them? What good things do advertisements do? What bad things do they do? A lot of the packaging of advertised products ends up as solid waste. How else is packaging used other than to protect a product? How is packaging used by advertisers? Have you ever bought or received something that did not turn out to be what the advertisement made it seem to be? How does advertising try to influence your thinking? How much does it cost to run an ad on TV? Why would someone pay that much money?

Assignments:

1. Send notes home asking parents' help in having students bring in an ad. For homework, have students determine good and bad points of the ad they have chosen.
2. Have students share and evaluate the ads they have brought in: What's good? What's bad?

EXTENDED LEARNING: Drama, Art or Music

1. Create an ad that either, by propaganda, encourages people not to buy so much, or presents a product in a fair, objective way. Videotape the children acting out the ad.

2. View the film "Free To Be You and Me" with Marlo Thomas or listen to the recording with the same title by Carol Channing. Discuss the song's message in light of the class's previous discussion about advertising.

PRE AND POST TEST QUESTIONS:

What is advertising?

What is the relationship between advertising and packaging?

What is propaganda?

BIBLIOGRAPHY: Thomas, Marlo. Free to Be You and Me. New York, N.Y.: McGraw Hill, 1974.

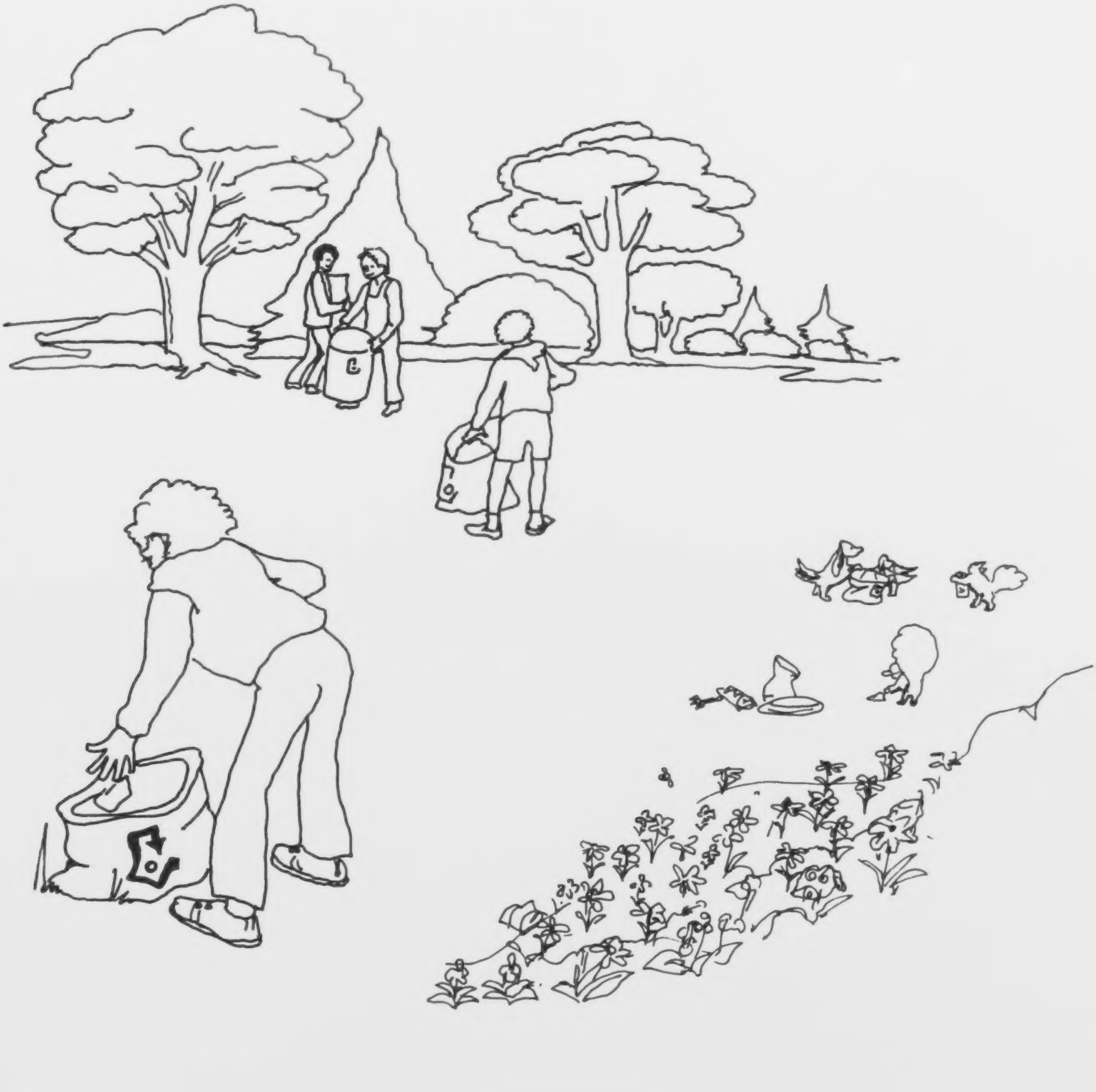
Sullivan, George. How do They Package it? Philadelphia, Pa.: Westminster Press, 1976.

Lauber, Patricia. Too Much Garbage. Chicago, Il. Garrard Publishing Company, 1974.

RESOURCES: Record: Channing, Carol. Free to Be You and Me.

Anti-Littering and Recycling PSAs, available from WDOE. To order see pages 343 and 344.

NURTURE SOME NATURE



TITLE: NURTURE SOME NATURE

USE WITH: Litter Is Waste Out of Place, p. 27.

RATIONALE: Any change in attitude or behavior toward litter begins with an awareness and knowledge of the problem.

SUBJECT: Social Studies, Language Arts

GRADES: Part I - 2,3 Part II - 4-12 Adopt a Park

LEARNING OUTCOME: By keeping an area in a park or other location free of litter, students will become aware of their responsibility and ability to solve the problem of litter.

TEACHER BACKGROUND: Persons convicted of littering are subject to a minimum fine of $50 and/or litter pickup time.

Litter bags are required by law in all vehicles and boats. Persons not complying with this law are subject to the $50 minimum fine.

It is illegal for a vehicle to be driven in this state with materials that are loose or falling off. Persons not complying with this law are subject to a flat fine of $108.

Call 1-800-LITTER (toll free) to receive a complimentary litter bag or to report motorists you observe littering. Report license number, make, color of vehicle, location, date, and time.

MATERIALS: WDOE or other bags to use for litter pickup. Refer to pages 343 and 344 for further information.)

(Optional) Contracts written by local park/recreation departments for volunteer community involvement.

LEARNING PROCEDUES:

Part I:

1. Instruct students to pick up one piece of litter on the way to school or on the school grounds. Hold up in front of class. What can you tell about litter from what we have gathered? What is litter? What kinds of things commonly end up as litter? Why do these things end up as litter instead of other things? Have students define what waste category each litter item falls into (i.e., glass, paper, aluminum, etc.). List on blackboard.
2. Ask students about their thoughts on litter. What do they feel about litter? Who litters? When? Why? Are there any dangers associated with litter? Are there fines? Why is litter bad? Where do you find litter?
3. Discuss facts about litter and recycling from the solid waste fact sheet. (p. 325)

4. Divide the class into teams, giving each a litter bag. Conduct a five-minute litter hunt contest on the school grounds. Use a whistle or some other method to signal the end of the hunt.

5. Gather students into a circle or return to the classroom to see which team picked up the most litter. Have awards for quantity, volume, or weight. Have students decide if they found anything that could be recycled.

6. The following are suggestions for projects using the collected litter:

   a. Drama -- Select a piece of litter. Use it to act out a scene telling its history. Start with the components of the object and trace their history up to the point at which the article is discarded.
   b. Creative Writing -- Do the same assignment in written form.
   c. Cartoon -- Draw a picture story about litter.
   d. Poster -- Use a piece of litter as part of an anti-litter poster for the school.
   e. Showcase -- Use the litter to create an anti-litter showcase or bulletin board for the school or classroom.

Part II:

As a follow-up to Part I, have students adopt a portion of land on the school ground, at the local park, a curbside, or some other part of town. They will be responsible as individuals, or as a class, club, family or school, to keep the area free of litter. The following Seattle Parks and Recreation "Adopt-a-Park" Plan is provided to help define responsibilities in litter pickup and as an example of a contract agreement you may want to make with the local park/recreation department or other city agency.

PRE & POST TEST QUESTION:

Can you think of an area near your home or school that has a litter problem? What can you do about it?

BIBLIOGRAPHY:

Wright, Dare. Edith and Little Bear Lend a Hand. New York, N.Y.: Random House, 1972.

Shuttlesworth, Dorothy E. Litter - The Ugly Enemy: An Ecology Story. Garden City, N.Y.: Doubleday, 1972.

RESOURCES:

Available from the Washington State Department of Ecology. To order see page 343.

Litterbags, three sizes: car bag, one cubic foot, and two cubic foot.

The Litterbug. Walt Disney Productions, 1955. 16 mm., 10 min., color.

CITY OF SEATTLE
DEPARTMENT OF PARKS AND RECREATION

SERVICE AGREEMENT FOR REGISTERED VOLUNTEER

The City of Seattle, acting by and through its Department of Parks and Recreation (called the "Department" herein), and ____________________ (called the "Volunteer" herein), agree as follows:

1. The Department shall:

   a. Provide the Volunteer with such training, supervision, staff support, work space and materials as the Department deems necessary to enable the Volunteer to perform his/her donated support services;

   b. Provide the Volunteer with personal injury and property damage liability insurance coverage at no cost to the Volunteer for any claims arising out of Volunteer's service as a registered Volunteer. This coverage shall not apply to the Volunteer's use of automobiles.

2. The Volunteer shall:

   Notify the Department when circumstances dictate termination of his/her volunteer service if prior to the date agreed upon in Section 3.

3. This agreement will be terminated: (check one)

   a. [ ] On ______________________________________
   MONTH DAY YEAR

   b. [ ] Upon conclusion of the program (or project).

   c. [ ] Upon 10-day written notice by either party to the other.

Dated this ____________________ day of ______________, 19__.

VOLUNTEER

NAME ____
Signature

ADDRESS ____

HOME TELEPHONE ____

VOLUNTEER POSITION OR PROJECT ______________________________

LOCATION ____

DEPARTMENT

SUPERVISOR ______________________________
Signature

TITLE ______________________________

OPTIONAL

Volunteer shall provide approximately _____ hours per week.

ADOPT A PARK

NAME ______________________ PHONE __________

YOUR PARK/AREA AND ITS ADDRESS ______________________

____

CHECK TASKS YOU ARE WILLING TO PERFORM:

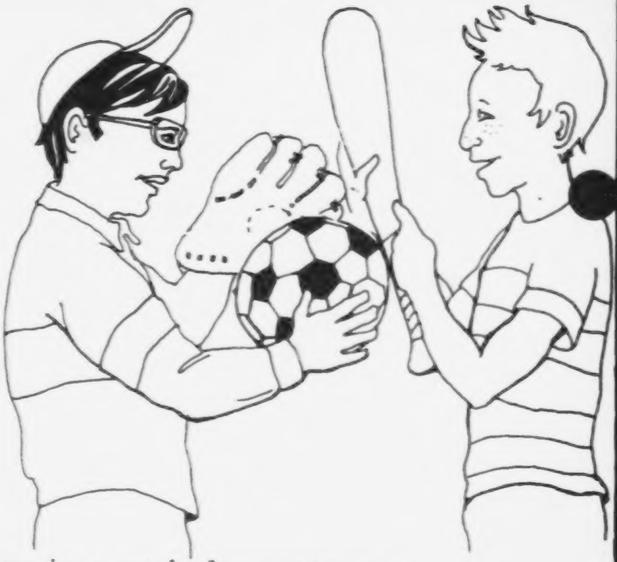
( ) Litter
( ) Mowing (need own mower)
( ) Watering
( ) Edging
( ) Weeding
( ) Leaf/Bush Gathering
( ) Report Vandalism & Repair Needs
( ) Play Area Maintenance
( ) Other __________

As a volunteer, I agree to help maintain but not to alter the present landscaping or design of a park. I realize that Parks Department personnel will also be working in the parks at given times and will give direction and coordination.

If you have any questions or problems, call Eleanor Mitchell at 625-4066.

Signed ______________________

Date ______________________



TITLE: SOMETHING OLD, NEW, BORROWED, BLUE

RATIONALE: A part of revising consumer habits is buying less. A part of buying less can be trading unwanted for wanted items - bartering - a swap meet.

SUBJECTS: Social Studies, Art

GRADES: K-6

LEARNING: OUTCOME: Students will see that trading is a good alternative to throwing away.

LEARNING PROCEDURE:

1. Direct a classroom discussion dealing with the following concepts:

    a. The world has finite resources.
    b. We are rapidly using up some of these resources.
    c. If we can trade things rather than buy things, we conserve natural resources.

2. Organize a swap meet:

    a. Discuss what trading is: (role play, if necessary, to demonstrate) What can you trade?

    b. Determine the scope of the swap meet: class, grade, schoolwide? A swap meet can be held during lunch, after school, or as part of a school-community fair.

    c. Set guidelines for:

        - Parental permission to trade objects
        - Contract agreements with date and signature if part of trade is forthcoming in the future
        - Trades involving intangibles or services such as guitar lessons, tutoring, time on friend's bicycle, or with friend's computer

    d. Emphasize trading as a solution to the problem of solid waste and as a way to conserve natural resources. Ask: How can a swap meet help make this happen? List responses on the blackboard. Use these responses in letters to parents and on posters advertising the swap meet. Working with students, draw up a contract form for trades involving intangible items or services.

3. Hold your swap meet. Two of many possible ways to conduct it are:

   a. Have students circulate and trade individually.
   b. Conduct the swap meet auction-style. Have an "auctioneer" offer each item.

4. Have students keep a list of what was traded and what resources were saved because of the swap meet. Discuss opportunities in daily life to trade items (garage and yard sales, individual exchanges, notification on bulletin boards in public places, etc.)

PRE AND POST
TEST QUESTIONS:

What does "finite" mean?
What is a natural resource?
List three finite natural resources.
Why are they finite?
What is bartering?
How can bartering and trading conserve these natural resources?
How can bartering save money? energy?
Will an increase in bartering reduce waste? How?
Do people today barter more than the settlers of our country? Why?

BIBLIOGRAPHY:

Proulx, Annie. "What'll You Take For It?": Back to Barter. Charlotte, Vt.: Garden Way Publisher, 1981.

Trapp, Jack. How to Barter and Trade. New York, N.Y.: Cornerstone Library, 1981.

TITLE: PLASTIC TRASH AND WILDLIFE

USE WITH: Litter, Litter Everywhere, p. 45. -- For elementary students

RATIONALE: "The pollution of oceans and beaches with plastic materials is on the rise, and sea birds, marine turtles, whales, and seals are suffering as a result."[1]

SUBJECT: Environmental Education, Home Economics, Social Studies

GRADES: 4-12

LEARNING OUTCOME: Students will learn the negative effects of plastic solid waste on wildlife and consider what each can do to avoid adding to this problem.

TEACHER BACKGROUND: Since the early 1970's, the amount of plastic in the marine environment has increased dramatically. Plastic negatively affects wildlife in a number of ways. Some animals, mistaking plastic for food, eat it. For example, approximately 15 percent of the world's 280 species of sea birds are known to have eaten plastic in the form of pellets, bits of styrofoam, even plastic toy soldiers. In addition, sea turtles, apparently regarding plastic bags as jellyfish upon which they regularly feed, have been found with balls of plastic in their stomachs. (One such ball, when unravelled, measured nine feet wide and twelve feet long.) Other animals found to have eaten plastic in one form or another are: whales, dolphins, bottom fish, a manatee, sea snails and worms, and plankton. Another damaging effect of plastic trash on wildlife is the entanglement of animals in everything from six-pack holders to plastic rings, discarded fishing line and nets. "Some government officials estimate that about 50,000 northern fur seals currently die in North Pacific waters each year as a result of entanglement in fishing gear.[2] "In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more than 52 million pounds of plastic packaging material into the sea and lost approximately 298 million pounds of plastic fishing gear, including nets, lines and buoys."[3]

Read the following notice "Plastics as Sea" from Natural History magazine. February, 1983.

LEARNING PROCEDURE: MATERIALS: Article "Plastics at Sea" from Natural History Magazine 2/83.

1. Have each student pick up or record all items of plastic litter and trash found in a 50-yard stretch along a beach, lake, river, or stream near his/her home. Bring lists or bags of litter to class.

2. Discuss: What nonrenewable natural resource is plastic made from? (petroleum) What uses other than making plastics can you think of for this resource? Referring to the collected plastic litter -- Ask: What other material or container could have been used in place of this piece of plastic? Why is plastic litter even more of a problem than many other kinds of litter? Where did all this plastic come from? Is it all litter discarded directly by people? Why do people litter? Do you litter?

3. Have students make a list of the wildlife commonly found in the area where the plastic litter and trash were recorded or collected. Ask: How will this plastic affect the wildlife we have listed? In what ways might this plastic litter endanger wildlife? Show accompanying pictures and share some of the information from Teacher Background. Ask: Why is so much of this material, with its negative effect on wildlife, manufactured? What can each of you do to lessen the negative impact of plastic trash on wildlife?

EXTENDED LEARNING: Have secondary students read "Plastics at Sea."

PRE & POST TEST QUESTIONS:

What nonrenewable natural resource is plastic made from?

Why is plastic litter even more of a problem than other kinds of litter?

In what ways does plastic waste and litter endanger wildlife?

SOURCE: [1,2,3]Wehle, D.H.S. and Felicia C. Coleman. "Plastics at Sea," Natural History Magazine, February, 1983, pp. 21-26.

RESOURCES: Field trips dealing with the marine and estuarine environment available at Padilla Bay National Estuarine Sanctuary: Breazeale-Padilla Bay Interpretive Center, 1043 Bay View - Edison Road, Mt. Vernon, Washington 98273, (206) 428-1558.

Plastics at Sea

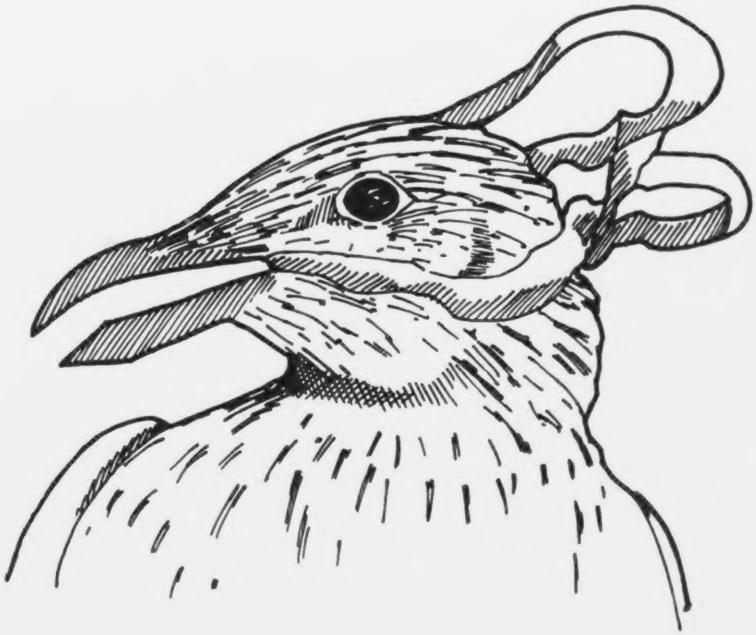
(Reprinted with permission from Natural History,
Vol. 92, No. 2; Copyright the American Museum of
Natural History, 1983.)

The pollution of oceans and beaches with plastic materials is on the rise, and sea birds, marine turtles, whales, and seals are suffering as a result.

by

D.H.S. Wehle and Felicia C. Coleman

Throughout the 1970s, a number of biologists studying the feeding habits of sea birds in different oceans of the world recounted the same story: the birds were eating plastic. Similar reports of plastic ingestion and of entanglement in plastic debris began to surface for other marine animals -- fish off southern New England, turtles off Costa Rica and Japan, whales in the North Atlantic. At the same time, plastic particles turned up in surface plankton samples from both the Atlantic and Pacific oceans; plastic debris was retrieved by benthic trawls in the Bering Sea and Britain's Bristol Channel; and plastic pellets washed ashore in New Zealand in such large numbers that some beaches were literally covered with "plastic sand." By the close of the decade, marine scientists around the world had become aware of a new problem of increasing ecological concern - plastics at sea.

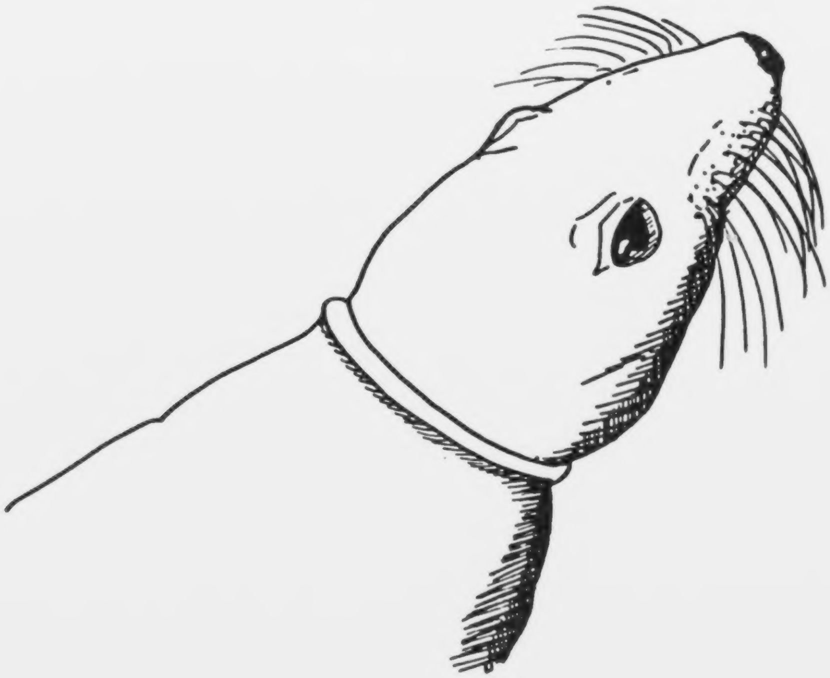


Gulls may get caught in six-pack straps.

Two forms of plastic exist in the marine environment: "manufactured" and "raw." Manufactured plastic material along beaches and adrift at sea is primarily refuse from transport, fishing, and recreational vessels. In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more than 52 million pounds of plastic packaging material into the sea and lost approximately 298 million pounds of plastic fishing gear, including nets, lines, and buoys.

Raw plastic particles - spherules, nibs, cylinders, beads, pills, and pellets - are the materials from which products are manufactured. These particles, about the size of the head of a wooden match, enter the ocean via inland waterways and outfalls from plants that manufacture plastic. They are also commonly lost from ships, particularly in the loading and unloading of freighters. Occasionally, large quantities are deliberately dumped into the sea.

Plastics turn up everywhere. Along portions of the industrialized coast of Great Britain, concentrations of raw particles have reached densities of about 2,000 pieces per square foot in benthic sediments. Near Aukland, New Zealand, 100,000 pieces of plastic were found every three lineal feet of beach. Particles have also washed ashore on beaches in Texas, Washington, Portugal, Colombia, Lebanon, and at such remote sites as the Aleutian and Galapagos islands.



As this seal grows, the plastic band will tighten.

Much of what we know about the distribution patterns and abundance of raw plastic in the world's oceans comes from plankton sampling of surface waters. Between 1972 and 1975, for example, the Marine Resources Monitoring, Assessment, and Prediction Program, a nationally coordinated program of the National Marine Fisheries Service, recorded plastic particles in plankton samples collected between Cape Cod and the Caribbean Sea. The majority of the particles were found to have entered the ocean from the coast of southern New England, and the highest concentrations were usually in coastal waters. Raw plastic, however, was ubiquitous in the open ocean and especially common in the Sargasso Sea. This suggests that winds and currents are instrumental in redistributing and concentrating particles in certain oceanographic regions.

Inevitably, many animals foraging in the marine environment will encounter and occasionally ingest these widely distributed plastic materials. One of the first records of plastic ingestion appeared in 1962 for an adult Leach's storm petrel collected off Newfoundland. Four years later, researchers in the Hawaiian Islands found that the stomach contents of young Laysan albatrosses contained plastic, apparently fed them by their parents.

For the most part, these early reports were treated as curious anecdotes included in studies of the feeding ecology of a few sea birds. During the 1970s and early 1980s, however, with the proliferation of such anecdotes, biologists are paying closer attention and were surprised to find how frequently plastic occurred in the stomach contents of certain Procellariids from the North Pacific and the North Atlantic (short-tailed shearwaters, sooty shearwaters, and northern fulmars) and alcids from the North Pacific (parakeet auklets and horned puffins). Lower frequencies were reported for other Northern Hemisphere sea birds, including phalaropes, gulls, terns, and also other procellariids and alcids. The feeding habits of marine birds in southern oceans have not been studied as extensively, but plastic ingestion has been documented for several species of procellariids (petrels, shearwaters, and prions) in the South Atlantic, South Pacific, and subantarctic water. To date, approximately 15 percent of the world's 280 species of sea birds are known to have ingested plastic.

Sea birds choose a wide array of plastic objects while foraging: raw particles, fragments of processed products, detergent bottle caps, polyethylene bags, and toy soldiers, cars, and animals. Marine turtles on the other hand, consistently select one item - plastic bags. In the past few years, plastic bags have been found in the stomachs of four of the seven species of marine turtles: leatherbacks from New York, New Jersey, French Guiana, South Africa, and the coast of France; hawksbills on the Caribbean coast of Costa Rica, greens in the South China Sea and in Japanese, Australian, and Central American coastal waters; and olive ridleys in the Pacific coastal waters off Mexico. Evidence points to plastic ingestion in loggerheads, as well, based on liver samples containing high concentrations of a plasticizer (a chemical compound added to plastic to give it elasticity). Polystyrene spherules have been found in the digestive tracts of one species of chaetognath (transparent, wormlike animals) and eight species of fish in southern

New England waters. They have also turned up in sea snails and in several species of bottom-dwelling fishes in the Severn Estuary of southwestern Great Britain.

Marine mammals are not exempt from participation in the plastic feast. Stomachs of a number of beached pygmy sperm whales and rough-toothed dolphins, a Cuvier's beaked whale, and a West Indian manatee contained plastic sheeting or bags. In addition, Minke whales have been sighted eating plastic debris thrown from commercial fishing vessels. Curiously, plastic has not been found in any of the thousands of ribbon, bearded, harbor, spotted, ringed, or northern fur seal stomachs examined from Alaska.

The obvious question arising from these reports is, why do marine animals eat plastic? In the most comprehensive study to date, Robert H. Day of the University of Alaska maintains that the ultimate reason for plastic ingestion by Alaskan sea birds lies in plastic's similarity - in color, size, and shape - to natural prey items. In parakeet auklets examined by Day, for example, 94 percent of all the ingested plastic particles were small, light brown, and bore a striking resemblance to the small crustaceans on which the birds typically feed.

Marine turtles also mistake plastic objects for potential food items. Transparent polyethylene bags apparently evoke the same feeding response in sea turtles as do jellyfish and other medusoid coelenterates, the major food item of leatherbacks and subsidiary prey of greens, hawkbills, loggerheads, and ridleys.

Sea birds, marine turtles, and marine mammals all eat plastic. So what? Perhaps ingesting plastic is inconsequential to their health. After all, cows are known to retain nails, metal staples, and strands of barbed wire in their stomachs for more than a year with no ill effects. For marine animals, however, the evidence is growing that in some cases at least, ingested plastic causes intestinal blockage. George R. Hughes of the Natal Parks Board, South Africa, extracted a ball of plastic from the gut of an emaciated leatherback turtle; when unraveled, the plastic measured nine feet wide and twelve feet long There is little doubt that the plastic presented an obstruction to normal digestion. Similarly, a mass mortality of green turtles off Costa Rica has been attributed to the large number of plastic banana bags eaten by the turtles.

The 20 dead red phalaropes discovered on a beach in southern California, all with plastic in their digestive tracts, present a less clear case. Did the birds suffer an adverse physiological response after eating plastic or were they already under stress because of a reduced food supply and eating the plastic in a last-ditch effort to prevent starvation? The same question applies to other instances of emaciated animals that have eaten plastic. At this time, we don't have an answer.

We do know that plastic is virtually indigestible and that individual pieces may persist and accumulate in the gut. Ingested plastic may reduce an animal's sensation of hunger and thus inhibit feeding activity. This, in turn, could result in low fat reserves and an inability to meet the increased energy demands of reproduction and migration. Plastic may also cause ulcerations in the stomach and intestinal linings, and it is suspected of causing damage to other anatomical structures. Finally, ingestion of plastic may contribute synthetic chemicals to body tissues. Some plasticizers, for example, may concentrate in fatty tissues, their toxic ingredients causing eggshell thinning, aberrant behavior, or tissue damage. When highly contaminated tissues are mobilized for energy, these toxins may be released in lethal doses.

Publication of data on plastic ingestion is in its infancy. As the problem gains notoriety, it will certainly be revealed to be even more widespread than is now recognized. There are already several known instances of secondary ingestion, in which plastic consumed by animals feeding at low trophic levels shows up in higher-level consumers. The remains of a broad-billed prion, together with the plastic pellets it had ingested, were found in the castings of a predatory South Polar skua in the South Atlantic; plastic pellets found in the Galapagos Islands were traced from transport vessels in Ecuadorean ports through a food chain involving fish, blue-footed boobies, and, finally, short-eared owls.

A more obvious effect of plastic pollution is the aesthetic one. Whether we venture deep into the woods, high atop a mountain, or out on the ocean to escape the trappings of civilization, our experience of the natural world is often marred by the discovery of human litter. Even more disturbing to the spirit is the sight of a young pelican dangling helplessly from its nest by a fishing line, a whale rising to the surface with its flukes enshrouded in netting, or a seal nursing wounds caused by a plastic band that has cut into its flesh. Unfortunately, such observations are becoming more and more common, another consequence of plastics at sea.

During the last 20 years, fishing pressure has increased dramatically in all the world's oceans, and with it, the amount of fishing-related debris dumped into the sea. In addition, the kind of fishing equipment findings its way into the ocean has changed. Traditionally, fishing nets were made of hemp, cotton, or flax, which sank if not buoyed up. These materials disintegrated within a relatively short time and, because of the size of the fibers, were largely avoided by diving sea birds and marine mammals. With the advent of synthetic fibers after World War II, however, different kinds of nets came into use. These new nets were more buoyant and longer-lived than their predecessors, and some of them were nearly invisible under water.

The result of these changes in net materials has been a tragic increase in mortality of air-breathing animals. A few examples are sufficient to give an idea of the magnitude of the problem. During the heyday (1972-76) of the Danish salmon fishery in the North Atlantic, the incidental catch of thick-billed murres amounted to three-quarters of a million birds annually; in 1980, 2,000 sea turtles off the southeastern coast of the United States drowned when incidentally caught in shrimp trawl nets. Incidental catch refers to nontarget animals that are accidentally caught in an actively working net. Another kind of net-related mortality is known as entanglement and refers to any animal caught in a net that has been lost or discarded at sea. Some government officials estimate that about 50,000 northern fur seals currently die in the North Pacific each year as a result of entanglement in fishing gear. Unlike working nets, which fish for specific periods of time, these free-floating nets, often broken into fragments, fish indefinitely. When washed ashore, they may also threaten land birds and mammals; in the Aleutians Islands, for example, a reindeer became entangled in a Japanese gill net.

Plastic strapping bands - used to secure crates, bundles of netting, and other cargo - are another common form of ship-generated debris. Discarded bands are often found girdling marine mammals, which are particularly susceptible to entanglement because of their proclivity for examining floating objects. The instances of seal entanglement in plastic bands has increased so remarkably in the past two decades that fur seal harvesters in Alaska and South Africa now monitor the number of ringed animals.

Sea birds that frequent recreational waters or coastal dumps are also subject to ringing by the plastic yokes used in packaging six-packs of beer and soda pop. Gulls with rings caught around their necks are sometimes strangled when the free end of the yoke snags on protruding objects. Similarly, pelicans, which plunge into the water to feed, run the risk of diving into yokes. If the rings become firmly wedged around their bills, the birds may starve.

Not all encounters with plastic prove harmful to marine organisms. Some animals are incorporating the new material into their lives. Algae, hydrozoans, bryozoans, polychaetes (marine worms), and small crustaceans attach to plastic floating at sea; bacteria proliferate in both raw and processed plastic refuse. Plastic provides these organisms with long lived substrates for attachment and transport; in some cases, hitching a ride on floating pieces of plastic may alter an organism's normal distribution. Several species of tube-dwelling polychaetes construct the tubes of raw plastic particles present in benthic sediments. Other invertebrates such as sand hoppers and periwinkles, find temporary homes in aggregates of plastic particles they encounter on beaches. Marine birds all over the world incorporate plastic litter into their nests, but in this case, the use of plastic may be harmful because chicks can become entangled in the debris and die.

Instances of marine animals adapting to this new element in their environments do not alter the predominately negative effect of plastics at sea. The problem is global and its solution will require international cooperation. Historically, the high seas have, in many respects, been considered an international no-man's land. Recently, however, perception of the ocean as a finite and shared resource has caused many nations to express concern for its well-being.

In 1970, the U.S. Congress passed the National Environmental Policy Act which, among other things, pledged to "encourage productive and enjoyable harmony between man and his environment." Subsequently, a number of laws on waste disposal were adopted, two of which affect pollution by plastics: the Federal Water Pollution Control Act (commonly known as the Clean Water Act) and the Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act). The Clean Water Act does not specifically address the problem of persistent plastics but does require all significant polluters of U.S. waterways to obtain a federal permit, under which limits are set on, among other things, discharges of solid matter. The Ocean Dumping Act prohibits the deliberate dumping of significant amounts of persistent plastic materials at sea. Having these laws on the books, however, does not immediately solve the problem. Small-scale refuse disposal on the high seas is difficult to regulate; fishermen who claim to have unintentionally lost their nets at sea cannot be held responsible; and illegal large-scale dumping at sea is hard to detect. Granted, laws must be tightened, but enforcement is really the bigger problem.

On the international level, the problems of water pollution and litter in the oceans were highlighted at the United Nations Conference on the Human Environment held in Stockholm in 1972. The conference, with 110 nations represented, defined the need for international policy on marine pollution among coastal and maritime nations. Treaties to implement such a policy soon followed: the 1972 London Convention on the Prevention of Water Pollution by Dumping of Wastes and Other Matter (Ocean Dumping Convention), a part of which specifically prohibits marine dumping of persistent plastic material; and the 1973 London International Convention for the Prevention of Pollution from Ships (Marine Pollution Convention), which is broader in scope and regulates the control of oil pollution, packaged substances, sewage, and garbage. While neither of these treaties has been adopted by all nations, they represent a start toward global control of marine pollution.

In the meantime, the quantity of plastics in the world's oceans will undoubtedly continue to mount. Ironically, the very characteristics that make plastic appropriate for so many uses - its light weight, strength, and durability - lead to the majority of problems associated with its presence at sea. As organic material, plastic is theoretically subject to degradation by mechanical, oxidative, or microbial means. Owing to the strength of most plastics, however, mechanical degradation by wave action is generally restricted to the breaking of large pieces into smaller ones. Photooxidation and microbial action are limited by plastic's high molecular weight and its antioxidants, ultraviolet light stabilizers, and biocide additives, which effectively immunize it against degradation. The longevity of plastics in seawater is not known, but on the beach, particles may last from five to more than fifty years.

Given plastic's long life and projected annual increases in production, one thing is clear - the rate of plastic deposition in the marine environment will continue to be higher than the rate of disappearance. In a study of the accumulation of plastic on the beaches of Amchitka Island, Theodore R. Merrell, Jr., of the National Marine Fisheries Service, recorded that 550 pounds of plastic litter were added to less than a mile of beach in one year. He also found an increase of more than 250 percent in both the number and the weight of plastic items washed ashore over a two-year period.

Outside the realm of laws and treaties, solutions to the problem can come from both inside and outside the plastic industry. The technology to manufacture biodegradable plastics is available. In fact, one of the beauties of plastic is that its properties can be altered and its life expectancy prescribed. Alaska has already taken steps toward reducing plastic litter by requiring that plastic six-pack yokes be made of a self-destructing compound. Another, but perhaps less workable solution, given the logistics and expense involved and the degree of business and public cooperation required, lies in recyclable plastics. At the very least, all countries should require that the discharge of raw plastic particles from industrial plants be reduced by filtering outflow before it enters waterways. A recent decline in the uptake of plastic marine organisms in southwestern England has been attributed, in part, to the efforts of one of the major contaminating plants to filter, collect, and reuse raw particles present in its effluent.

Consumers share with industry the responsibility to reduce the amount of plastic in the sea. Recreational boaters, beach-goers, and commercial fishermen all discard plastic refuse. Preferably, no trash plastic - bands, netting, or other debris - should ever be tossed overboard or left on a beach. If six-pack yokes or strapping bands must be discarded at sea, the rings should be cut first so that they pose less of a threat to marine animals.

The first step in combating plastic pollution is to alert both industry and the general public to the gravity of the problem and the need to do something about it soon. Education alone cannot solve the problem but it is a beginning. Public awareness of a problem, combined with the resolve to correct it, can bring dramatic results.

Both D.H.S. Wehle and Felicia C. Coleman are free-lance writers and artists and teach at Cornell University's Shoals Marine laboratory on Maine's Isles of Shoals during the summer.

TITLE: WHY BURY WASTE?

USE WITH: Making A Mini Landfill, p. 32.

RATIONALE: A great need exists to reduce waste and reuse and recycle products. Nevertheless, society will always have wastes and residues that must ultimately be disposed of in landfills.

SUBJECT: Language Arts, Social Studies

GRADES: 3-6

LEARNING: OUTCOME: Students will understand that society must provide for land disposal.

LEARNING PROCEDURE:

1. Divide students into groups. Have each choose a spokesperson.
2. Give each group an item which can no longer be used as it was intended to be used, and has no more useful life. (Suggested items: torn plastic bag, torn paper bag, sprung paperclip or clothespin, ruined piece of clothing, wornout shoe, unravelled cassette tape, broken record.)
3. Ask students to speculate about the "life" -- the history and experience -- of their item for three minutes. Then ask the spokespersons to summarize the group discussions.
4. Ask groups to think of large items which, despite repair and reuse, will someday reach the "end of the road." Ask: "What can be done with these?"
5. Explain that land disposal currently seems to be the least costly way to dispose of items which have no usefulness left.

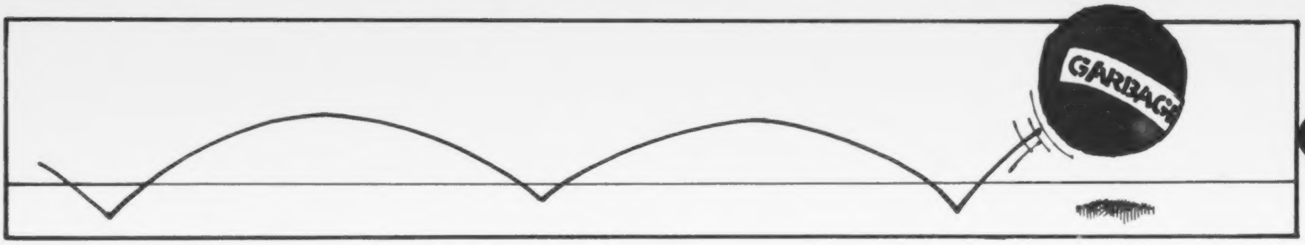
6. Draw or supply information about the local garbage collection services -- where the landfill is and how much disposal costs per household.

7. Explain that communities must plan for waste disposal even if reuse and recycling are practiced by everyone.

RESOURCES: Available from the Washington State Department of Ecology. To order, see page 343.

Garbage. Educational Media, 1969, 16 mm., 10 min., color.

Solid Waste Slide Show, Washington Department of Ecology, 1984, 15 min., color.



TITLE: OUT OF SIGHT, BUT NOT OUT OF MIND

RATIONALE: Illegal dumping by a few degrades our land and waters and imposes costs on society that all bear.

SUBJECTS: Social Studies, Math

GRADES: 3-8

LEARNING OUTCOME: Students will know where to dispose of waste.

MATERIALS:
Nerf ball
Paper money
County map

LEARNING PROCEDURE:

1. Bring in a small nerf ball. Mark it "Garbage." Hide it in one of the desks.
2. Tell students that garbage is hidden in one of the desks or student boxes. It is like a "hot potato." The idea is to make it someone else's responsibility and, above all, not to be caught with it.
3. Supply the students with paper money - 10 $10.00 slips each. The money will be used to pay a $30.00 fine if you are caught illegally dumping the garbage. Explain that illegal dumping is discarding garbage along roadsides or in the woods, where it degrades the beauty and health of nature. Explain it is unlike most littering in that illegal dumping can be considered a deliberate, malicious act. (See activity "Plastic Trash and Wildlife" P.58.)

   Periodically, the teacher will call for each student to fork over $10.00 to cover the community cost of cleaning up illegal dumps.

   (NOTE: This game may instead be played like a "catch" game to music. Whoever is caught when the music stops must pay for the garbage.)

4. Tell students that a 1983 Department of Ecology study of 13 western Washington counties discovered 1,056 illegal dumps containing 2,400 tons of trash. The study states: "Projecting these figures statewide for a population of 4,264,000, there are a minimum of 6,400 sites and 12,800 tons of solid waste."[1] Citizens who encounter illegal dumps can report them by calling 1-800-LITTERS or their County Health Department.

5. Ask: Why do people dump waste illegally. (Fees at landfills, distance to landfill, hours landfill is open.) Explain that illegal dumping occurs more often in rural and undeveloped suburban areas than urban areas, and that illegal dumps are magnets for more illegal dumping.

6. Tell students that the penalty for illegal dumping a county may impose will be higher than the fee charged at the local landfill.

7. Help students to identify on a county map where in the community people can recycle or legally dispose of wastes.

8. Stress that through careful buying and recycling we can prevent many things from becoming garbage.

PRE & POST
TEST QUESTIONS:

What is illegal dumping?

Why would people decide to dump waste illegally.

In what ways does illegal dumping degrade the environment?

Why does illegal dumping cost all of us?

SOURCE: [1] Washington Department of Ecology. "Indiscriminate Solid Waste Dump Survey." Final Report." Olympia, Washington, 1983. p. 1.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Solid Waste Slide Show, Washington Department of Ecology, 1984, 15 min., color.

TITLE: WOULD YOU DO IT IF I TAUGHT YOU? IF I PAID YOU?

USE WITH: You Can Get There From Here, p. 292.

RATIONALE: Education and a sense of responsibility for the health of the the environment will increase recycling, but immediate financial reward is also a powerful catalyst to action.

SUBJECTS: Social Studies, Economics, Business, Environmental Studies

GRADES: 3-12

LEARNING OUTCOME: Students will understand that financial reward -- the profit motive -- plays an indispensable role in making recycling happen.

MATERIALS: Large litter basket/can
Scale to weigh collected litter.

LEARNING PROCEDURE:

1. Week 1. Without any prior discussion about the problems caused by litter and other solid waste, ask students to bring in litter from outside the classroom to put in the litter basket. Stress that the litter should be raided from household or school trash cans. At the end of one week, weigh the collected litter.

2. Week 2. Do litter lessons from A-Way With Waste; e.g., "Plastic Trash and Wildlife" p. 58, "Litter, Litter Everywhere" p. 45, "Nurture Some Nature" p. 52. Encourage students to act on what they've learned in these lessons by picking up litter for proper disposal in the litter can. At the end of the second week, weigh the can again.

   What effect did education have on the amount of litter collected?

3. Week 3. Say something like "You've been doing a pretty good job bringing in litter, but I'm still noticing litter around the school and in the neighborhood so I am going to give a reward if you pick up even more litter and things look a lot cleaner by the end of the next week." Rewards might be: Free time, extra recess, story reading, money, snack, or party time, etc. At the end of the third week, again weigh the collected litter. Give rewards, if earned.

4. Put the information from the three weeks on the blackboard or overhead.

Week	Motivation	Results-Amount of Litter Collected
1	Request	
2	Education	
3	Reward	

Ask: What were the differences between the weeks in terms of the amount of trash collected? Other differences? During which week was the most litter collected? The least? Why? Why was there a change between weeks?

Ask: Which would give best results?:

a. Asking someone to do something (Pick up litter or recycle)
b. Giving reasons why and asking someone to do something
c. Giving reasons why and rewarding someone for doing something

5. Why do people operate recycling centers: a, b, or c?

6. What would happen if recyclers were not rewarded (paid)? Would others save things to be recycled? Why or why not?

PRE & POST
TEST QUESTIONS:

What is the best way to motivate people to not litter?

TITLE: COMMERCIALS WITH AN ENVIRONMENTAL MESSAGE

USE WITH: Ads Add Up, p. 49, Public Service Announcements - Can You Say it Better?, p. 126, and What's the Appeal?, p. 123.

RATIONALE: Many products, in addition to being desirable or useful to the consumer, have an impact on the environment. These effects on the environment may not normally be considered by advertisers or purchasers.

SUBJECT: English, Speech, Social Studies

GRADES: 3-12

LEARNING OUTCOME: Students will learn that commercials can be brief, entertaining, and promotional and still take into consideration the environmental consequences of a product. This understanding encourages students to take these environmental impacts into consideration when buying.

LEARNING PROCEDURE: Students will revise a current commercial or write a commercial for a new product that is brief, entertaining, and promotional and presents the environmental consequences of a product. This will be performed before the class as a skit. (Videotape and play back, if you have access to equipment.)

1. Notify students of the assignment and allow several days for them to view TV commercials noting any references to environmental impacts of the products advertised, or do this activity as a follow-up to What's the Appeal, p. 123.
2. Have students discuss five advertisements in detail, explaining how the commercials could have been changed to include positive environmental impact. If a product does not have a positive environmental impact, have students create a new product.
3. Have students create a political ad highlighting a candidate's reaction or campaign promises about landfills, waste burners, recycling, etc.
4. Allow sufficient time for students to write their commercials containing environmental messages.
5. Have students present their commercials, include use of props, cue cards, etc. (Note: If commercials are to be videotaped, the teacher may want to allow extra time for students to feel at ease in front of the camera.)

Examples:

Juice in cardboard boxes versus juices in aluminum cans; returnable, refillable bottles versus nonreturnable, nonrefillable bottles; recyclable glass bottles versus nonrecyclable plastic bottles.

PRE & POST TEST QUESTIONS:

Why should we consider the problem of disposal before we purchase a product?

BIBLIOGRAPHY:

Liston, Robert A. Why We Think as We Do. New York, N.Y.: F. Watts, 1977.

Houlehen, Robert J. and Elvajean Hall. The Battle for Sales. Philadelphia, Pa.: Lippincott, 1973.

National Association of Consumer Agency Administrators. Advertising, Packaging and Labeling. Washington, D.C.: U.S. Department of Commerce, Office of Consumer Affairs, 1980.

Freeman, David J. ed. Key Social Issues for Packaging in the 1980's. New York N.Y.: AMACOM, 1980.

Claussen, Eileen. Packaging Source Reduction: Can Industry and Government Cooperate? Washington, D.C.: U.S. Environmental Protection Agency, October 9, 1974.

TITLE: SOLID WASTE SURVEY

USE WITH: Out of Sight, But Not Out of Mind, p. 70.

RATIONALE: Most people are not aware of the size of the solid waste problem in their community or of the expense required to deal with it.

SUBJECT: Language Arts, Social Studies, Math

GRADES: 4-8

LEARNING OUTCOME: Students will become aware of specific facts to help them understand what happens with solid waste in their community.

LEARNING PROCEDURE:

Step A. Organize the class into six research groups. Have each group find information on one or more of the following questions. Select a representative from each group to work on a committee to compile all information and produce a fact sheet, newsletter, poster, or other publication.

1. What is the population of your community? How many families? Check growth over past ten years by county. (Obtain information from your city hall or the United States Bureau of the Census.)
2. How many tons of garbage does your community dispose of each day? (This information may be obtained from the City or County Department of Public Works or the Department of Sanitation).
3. How many pounds of garbage are disposed of per person per day? Per year? (The average in Washington State is 4.6 pounds per person per day. This is averaging in industrial and agricultural wastes as well.[1] The population of Snohomish County, for example, produces about 3.1 pounds of mixed municipal solid waste per person per day.[2])
4. How much does it cost to dispose of the waste per ton? (The average cost to landfill in 1976 was $30 per ton in Seattle; $35 in Snohomish County in 1983.)
5. How is garbage disposed of in your community? Is it burned or buried? Is any of it subject to resource recovery processes or organized recycling; for example, separate collection of newspapers, cans, and bottles?
6. Are there other recycling programs in your town? Are they run by the city or by private citizens?

7. Invite a city or county solid waste manager and a recycler to speak to the class.

Step B. Have each research group decide upon the best way to present its information. For example:

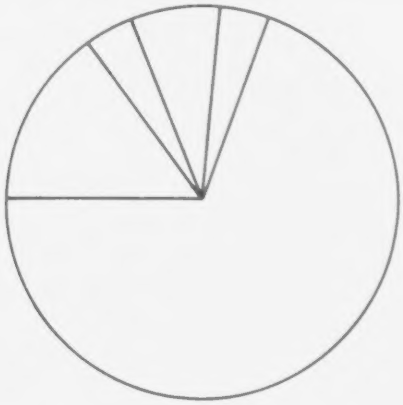
1. Prepare a graph comparing county population growth over the past ten years with growth of the volume of solid waste.

2. Prepare a poster depicting the individual's daily contribution to the community's solid waste. Divide the population of the community into the tonnage of waste per day. Calculate the annual contribution of each individual.

3. Prepare a layout and compare the costs of the following in your school and community with the costs of solid waste disposal for a year. For example:

Program	Cost per year	Cost per individual per year
Solid Waste Disposal		
School Basketball Program		
School Band Program		
Fire Department		
Police Department		

4. Prepare a pie chart showing the relative costs of the various school and community programs and services, including solid waste disposal. An example:



5. Discuss how recycling could reduce your community's solid waste and the expense of its disposal.

PRE & POST
TEST QUESTIONS:

How is solid waste disposed of in your county?

On the average, how much solid waste per day is produced by each citizen of Washington State?

In your county, how much does it cost per ton to dispose of solid waste?

SOURCES:

[1] Avery Wells, Washington Department of Ecology, Solid Waste Division, Olympia, WA., 1983.

[2] Allen Fitz. Snohomish County Solid Waste Division, Department of Public Works, Everett, WA., 1985.

RESOURCES:

Available from the Washington State Department of Ecology. To order see page 343.

WDOE Solid Waste Slide Show, 1983.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE: THE THROWAWAY THREE (a skit, copy is attached)

USE WITH: Wise Use of Paper, p. 201.

RATIONALE: We can't throw away our trash. There simply is no such place as "away." Care is always required to prevent our trash from having bad effects on our lives.

We can't burn it all. Most of the burning requires expensive, and often elaborate controls, to prevent air pollution. There is always ash or something left over which must be buried.

We can't bury it all. Not enough places are available. Besides plastics and modern synthetics do not rot when buried.

We are literally running out of some natural resources so that any form of disposal of certain goods is self-defeating.

SUBJECT: Social Studies, Language Arts, Drama

GRADES: 4-6

LEARNING OUTCOME: Students will become aware that historical methods of getting rid of solid waste (throw it, bury it, or burn it) won't solve modern urban garbage problems.

MATERIALS: Skit script, props

LEARNING PROCEDURE: Prepare materials as described in the skit script on the following sheets. Encourage students to make props and costumes from recycled or reused materials. Work with students to develop a production which could be performed for other classes, for parents, or for a group in the community.

PRE & POST TEST QUESTIONS:

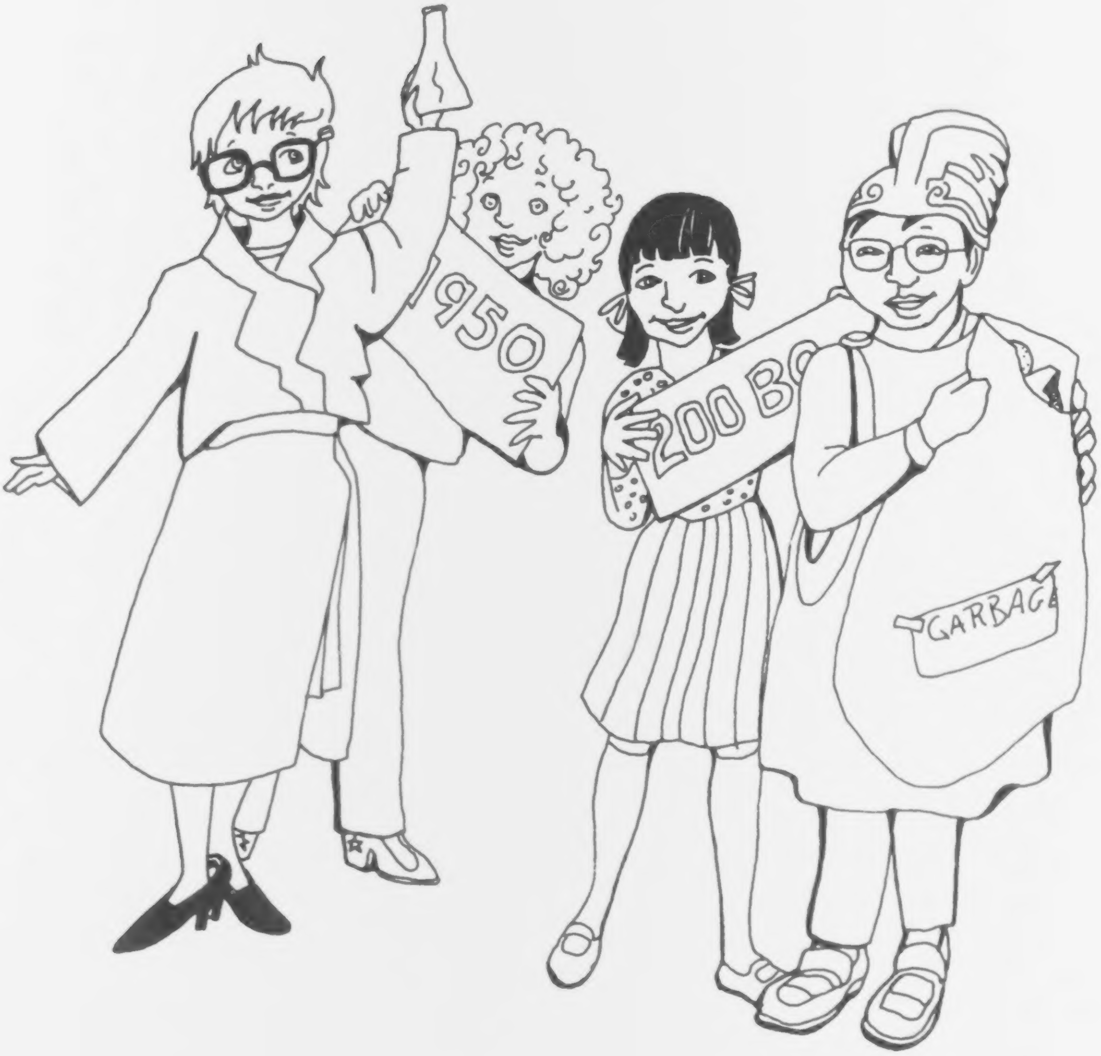
List three waste disposal problems today's society must solve which did not exist 100 years ago.

Explain how this skit helped you find ways to solve your waste problems.

Who were litter makers in this skit?

BIBLIOGRAPHY: Bradley, Fay. "Throwaway Three," Lessons From Litter. Atlanta: Atlanta Clean City Commission, 19__.

United States Environmental Protection Agency. Let's Recycle!: Lesson Plans for Grades K-6 and 7-12. Washington D.C.: Office of Waste and Waste Management, 1980.



The central idea is that as the skit progresses, each person throws more trash on the pile in the middle of the room so that a high stack is created. The skit suggests that one way to solve the problem is to recycle. A discussion of ways to solve the problem of too much garbage and trash might follow the performance.

THE THROWAWAY THREE

PROPS

Person 1

This is the tale of the Throwaway Three,
Of Man and his Garbage throughout his-to-ry:
Now they're very nice people, just like you and me,
Who all have a problem, as you will soon see--
What shall they do with their garbage and trash?

All

Why, throw it! Or bury it! Or burn it to ash!

Person 2 - 90,000 BC (Monkey)

I represent people when we lived in a tree.
I get rid of garbage so easily!
It's a snap! It's no problem - to me or to him.
We just let go, plop! Down through the limbs.

Monkey Masks
Banana Peel

Person 3 - 50,000 BC (Cavedweller)

I am a cave dweller who lives on the ground.
What do I do with old stuff all around?
Why, burn it, like meat; burn it up in the fire;
Or bury it like bones, in the muck and the mire.

Skins

All

Yes, throw it, or bury it, or burn it to ash!
That's how we always get rid of our trash!

Person 1 - 200 BC (Roman)

I am a Roman who lives in the town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile
And then I can dump it, forget it, and smile!

Roman Helmet
Bag of Trash

Person 2 - 1200 AD (Briton)

I am a Briton, wary and quick;
Down on our street it can get pretty thick.
When housewives up there want to pitch out their goo,
They just leave it out there and yell: "Gardy-loo!"
  (Person 1 stands on chair and yells, "Gardy-loo!")
It will stay there and stay there until the next rain,
Or until our fair London should burn down again.

Stack of trash

All

Oh, what do we do with our garbage and trash:
We throw it, or bury it, or burn it to ash!

Person 3 - 1630 (Settler)

Pilgrim Hat

I am the settler. I came without much,
But everything else I must make with my hands.
So I don't throw out much -- I use all I can.
Cloth scraps become quilts; I reuse my bent nails
It will be a long time 'fore the next trade ship
sails.

Person 1 - 1700 (Colonist)

Coonskin Hat
Leather

I am a colonist; now life's not so tough.
We have trade between cities that brings lots of stuff
And some things are made by our townfolk today,
I could buy a new harness, throw this old one away.
We have pigs and hogs running loose in our street,
If I toss it out there, they'll eat it up neat!

Or I might bury it right over there.
Or I might burn it; nobody would care.
You see; the New world is the same as the Old!
We trashmakers come from the time-honored mold.

All

What are we still doing with garbage and trash?
You guessed it! Throw it away, or bury it, or
   burn it to ash!

Person 2 - 1890 (Industrialist)

Engineer's Cap
3 Sweaters
(One handmade;
two machine-made)

I'm the industrial person and new on the scene,
I mass-produce goods with my trusty machine.
This sweater, handmade, took a week in days of yore,
But now in one hour, I can make forty-four.
I make things so cheaply, you can now afford two,
And throw out twice as much trash as you need to do.

Person 3 - 1950 (Scientist)

Lab Coat

I am the scientific person in the new post-war age.
We've learned a few tricks while the war shortage raged.
When we couldn't get natural stuff to process
We invented synthetics to replace the rest.

Person 2 (Industrialist)

Nylon stockings
Plastic Bags &
Containers

Rayons and nylons, acrylics and plastics,
For furniture and clothing and even elastics;
Forget your old woolens and silks and your cotton;
Real wooden toys and washboards are forgotten.

Person 1 (Scientist)

Our new stuff will last 'til forever, you see
Even when it's worn out to you and to me.
Permanent pressed, pre-sized and pre-shrunk
When dingy and old, it's still permanent "junk"
(Person 1 yells, "Junk")

Perma-pressed shirt

Person 2 (Industrial)

We make instant menus that come in a PACK.
You just boil the food in its own plastic sack.
Or our TV dinner in its tinfoil tray
It's quick; you don't wash it; just throw it away!

Plastic Bag
TV dinner

Person 3 (Scientist)

We make lots of TVs and clothes dryers, too.
Don't ask for a trade-in; you're kidding, aren't you?

Broken Small Appliance

Person 2 (Industrialist)

Our new cars all change with each model year,
Don't try to repair them, the cost's much too dear.
Besides, we don't bother to make last year's parts
For Skylarks, or Novas, of Cougars, or Darts.

Toy Car

Person 3 (Scientist)

It's the New Thing, the NEW that America craves.
So out, out with the old stuff, away to its graves.

Person 2 (Industrialist)

So what if there're more of us buying more goods?
So what if they won't rot away as they should?

Person 1 (Indian)

Now wait just a minute! You cannot fail
To include me in your historic trash tale.
We Indians lived simply, on prairies, in woods,
We made no high trash piles, nor mass-produced goods.
Let me be your critic, show you where you stand;
And tell you just how you're defiling our land.
Your new-fangled goods will not rot away.
When you throw them all down they remain where they lay
Then you say you will bury them deep in the ground:
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up our air with smoke, deadly gases!
Oh, all of your answers have faults everywhere:
You'll either ruin the water, the land, or the air.
What's more, your resources--your lumber, your ore--
Get smaller each year than the year before.
And what's more--this old earth's not making any more.

Indian Headband

Person 2 (Industrialist)

You're right. Our resources are shrinking away While our garbage problem grows bigger each day. We're always converting resources to refuse Instead of recycling them for reuse!	Throw Out Old Blanket and Cola Bottle

Person 3 (Scientist)

Oh stop it! Don't drop it! We'll think of a way To make food for cows that's much better than hay. Don't burn it, return it--we'll make something new, A vase for your mother, a spyglass for you.	Pick Up Orange Peels Clear Bottle Flower

(Flower in bottle for vase, flower out, bottle held up to eye for spyglass)

Don't bury it, carry it--back to the mill.
We'll make a new blanket to ward off the chill.

(Pick up old blanket and wrap around shoulders)

Person 2 (Industrialist)

It's time we progress past the Disposal Age
And make recycling the popular rage!
We'll have to give up old solutions for trash
And all realize that its pure balderdash - to just

All

Throw it, or bury it, or burn it to ash!

DISCUSSION

The skit shows children that people have historically gotten rid of solid waste successfully by throwing it out, burying it, or burning it. But none of these methods solves modern urban garbage problems. The discussion should attempt to reinforce this concept. One way this can be done is to discuss the characters in the skit: how they disposed of their garbage or trash and why their method of doing so was either satisfactory or not satisfactory.

Monkey: Threw it down. No problem developed because no large concentration of monkeys existed.

Cave dweller: Threw it, burned it, buried it. These acts still did not cause a problem for the same reasons.

Roman: Threw it. Tossing out garbage began to be a problem because of the many people who lived in cities, but it was easily solved by taking the garbage out of the city.

Briton: Threw it. A problem grew because more and more people moved to the cities, thus producing more trash than they could get rid of in the city.

Settler: Had virtually no garbage.

Colonist: Threw it, burned it, buried it. With greater trade came more things to be discarded.

Industrialist: With a greater concentration of people in cities than ever before, and more buying because machine-made goods were cheaper, much more was thrown out.

Scientist: The big change to synthetics plus the use of enormous amounts of natural resources are causing tremendous problems.

TITLE: TAKE A BITE OF THE FINITE

USE WITH: Nonrenewable Resources: How Long Will They Last? p. 253, Thermodynamics, Litter and Resource Recovery, p. 105, and How to Calculate BTU's Per Container, p. 152.

RATIONALE: As countries become more industrialized and developed, they consume more and waste more finite resources.

SUBJECTS: Social Studies, Math

GRADES: 6-12

LEARNING OUTCOME: Students will understand that some resources, including resources lost in landfills, are finite.

MATERIALS: Beads of various colors

LEARNING PROCEDURE:

VERSION ONE

1. Select beads of different colors to represent resources that often end up as wastes.

Color	Beads	Finite Resource	1982 Estimates of Global Reserve[1]
a. blue	150	aluminum in bauxite	5610 million short tons*
b. red	294	tin	10,000 million metric tons
c. purple	1	silver	8400 million troy ounces
d. green	15	copper	511 million metric tons
e. yellow	3	iron in ore	108 million short tons
f. orange	4	lead	146 million metric tons

*Short ton = 2,000 pounds

*1.1 short tons = 1 (long) metric ton = 2,200 pounds

NOTE: The numbers of beads reflect a mineral's relative, estimated total abundance -- not that mineral's ease of extraction or potential availability.

2. Scatter beads throughout the classroom and have students divide into teams representing countries. (Make sure some of the beads are hidden so well they will not be immediately found.)

3. Give teams time intervals of three minutes, one minute, and 30 seconds to explore for resources.

   a. After each exploration, students are to separate and categorize beads.

   b. Discuss the greater difficulty in finding resources during the second and third periods of exploration.

c. Is competition for resources emerging between countries? Think of examples.

4. What can you do to extend the life of finite resources? What are the advantages of extending the life of resources? (More resources available in the future, lessening of international conflict.)

5. Examine and discuss the following charts: Alternative Depletion Patterns for a Nonrenewable Resource (p. 254) and Selected Nonrenewable Natural Resources; Their Life Expectancies and Prime Consumers. (p. 255)

LEARNING PROCEDURE:

VERSION TWO.

1. Hide beads throughout the room keeping the colors in large groups to represent concentrated ore deposits. Hide some beads very well. Also hide one or two differently colored beads to represent rare strategic metals such as chromium and titanium. Divide students into countries: two superpowers (such as the United States and the Soviet Union, three students to a country), two small industrialized countries (such as Japan and Sweden, one student each), four developing -- third world countries (such as Brazil, India, Zimbabwe, Guinea, four students each). The number of countries can be changed but the relative numbers should be kept the same. The idea is to reflect the world's unequal distribution of population and resources.

2. Have students consider the implication of the fact that some rare strategic minerals may be found in countries controlled by hostile or repressive governments.

3. Have students explore the possibilities of what to do about local shortages of resources. Possible solutions include: recycling, conservation, trading, treaties, etc.

4. Given the ideas outlined in this activity, have students develop their own learning activity or game (e.g. Risk).

5. Consider extending this activity by adding money to buy resources, setting up cooperative ventures between countries, forming resource cartels, etc. "An enterprising teacher could take this game as far as imagination and time allows." Mike Harves, Davis High School, Yakima, Washington.

PRE & POST
TEST QUESTIONS:

How does competition for natural resources contribute to international tension?

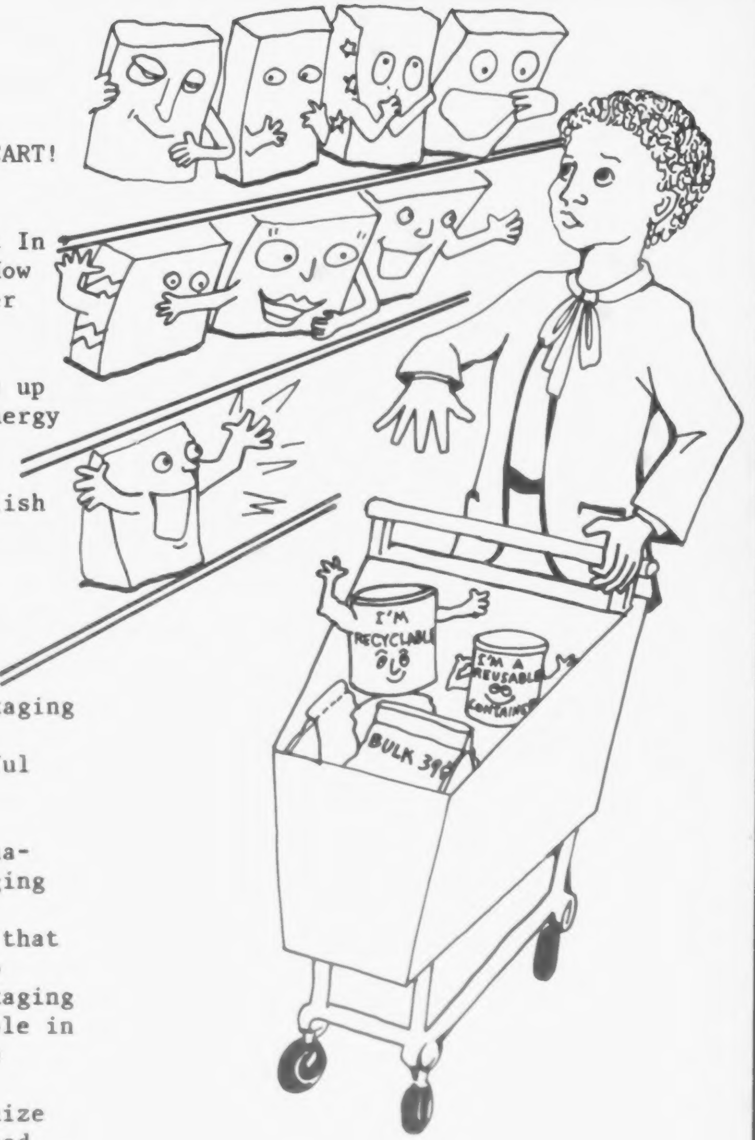
What is the relationship of competition for resources and war?

How do nations try to control finite natural resources?

What happens when nations try to control the supply of finite natural resources?

SOURCE: [1] U.S. Bureau of Mines, 1983 Mineral Commodities. U.S. Government Printing Office, Washington, D.C. 1983.

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, WA: Washington State Office of Environmental Education, Northwest Section, 1979, Revised 1983.



TITLE: NOT IN MY SHOPPING CART!

USE WITH: Putting Your Product In A Package, p. 107, How to Calculate BTUs Per Container, p. 152.

RATIONALE: Packaging often ends up as waste and uses energy and raw materials.

SUBJECTS: Home Economics, English

GRADES: 5-12

LEARNING OUTCOME: Students will:

- Understand the purpose of packaging
- Identify wasteful packaging
- Identify alternatives in packaging
- Identify steps that can be taken to affect the packaging options available in the marketplace
- Learn to recognize products packaged in recycled materials

LEARNING PROCEDURE:

1. Ask students to bring to class examples of packaging.
2. Discuss the packaging:
    a. Which products need the protection of packaging?
    b. Which products need packaging to protect public health, prevent theft, provide advertising, or convenience, etc.
    c. Which packaging is recyclable?

d. How can you tell which paper packaging has been made from recycled materials? (Look for the recycling emblem, and if the paperboard is gray, it was probably made from recycled paper.)

e. Is any of the packaging unnecessary or excessive?

f. Which products can be sold in bulk?

g. What are the advantages to larger quantity products? (a 3 oz.-tube of toothpaste requires 50 percent more packaging per ounce than the 7 oz.-size.)

h. Which natural resources were used to make the packaging?

i. Could the package have been made to be more conservative of resources or energy?

j. Could this product be purchased in less wasteful packaging?

3. In order to preserve natural resources and protect the environment, consider doing the following:

   a. Avoid products packaged in polyvinylchloride containers (clear, semirigid, plastic-like containers which frequently hold shampoo, hand lotion, mouthwash, and cooking oil). These petroleum derivatives do not biodegrade and may give off poisonous fumes when incinerated.

   b. Limit prepackaged and precooked foods. Cooking from scratch saves energy, costs less, and is more nutritious.

   c. Durable shopping bags, string bags, and knapsacks can serve as alternatives to plastic sacks.

4. Discuss steps that can change marketing practices. Possibilities:

   a. Not buying overpackaged products;

   b. Letters encouraging retailers to carry returnables and recyclables (e.g., glass milk containers).

   c. Letter to legislators urging container standardization legislation which would make possible an expanded system of returnable, reusable containers.

d. Letters to manufacturers suggesting changes in amount or design of packaging.

e. Letters to packaging companies urging increased use of recycled/recyclable materials in packaging.

PRE & POST
TEST QUESTIONS:

Why do we sometimes need packaging on the things we buy?

List three examples of packaging materials that are recyclable (glass, aluminum, cardboard).

How might you influence manufacturers, wholesalers and retailers of packaging to take into account the waste disposal and resource use issues and problems related to packaging?

How does recycling help grocery stores cut disposal costs?

How can you reduce the amount of packaging you throw away?

BIBLIOGRAPHY:

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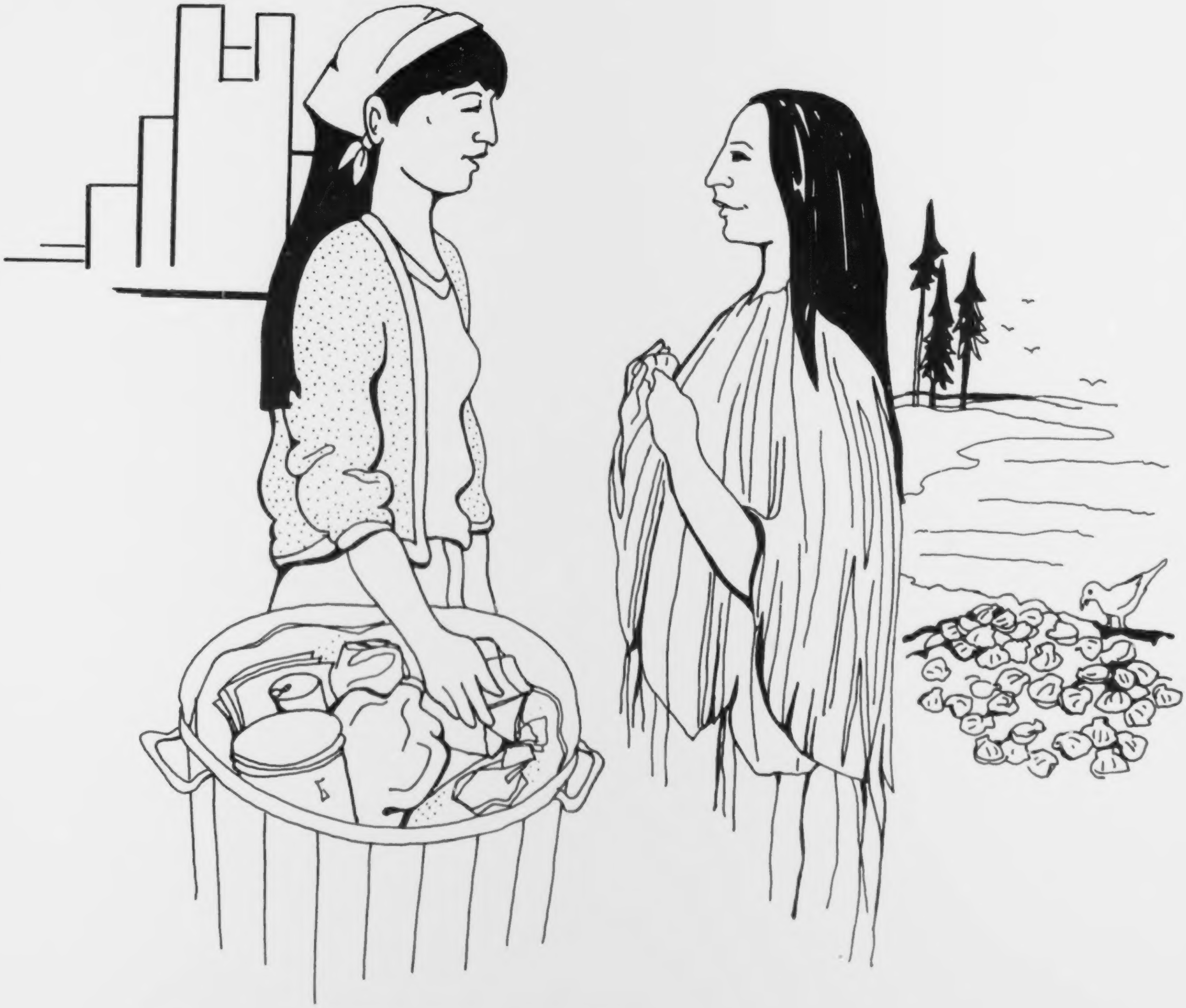
National Association of Consumer Agency Administrators. Advertising, Packaging, and Labeling. Washington, D.C.: U.S. Department of Commerce, Office of Consumer Affairs, 1980.

Oregon Department of Environmental Quality. Curriculum Unit on Packaging for Possible Use in Home Economics Class. Portland, Oregon: Recycling Information Office, 19__.

Sullivan, George. How Do They Package It? Philadelphia, PA: Westminster Press, 1976.



TITLE: WASTE, THEN AND NOW

RATIONALE: Americans are often pictured as very wasteful in the consumption of goods and materials. According to one article, "Americans are the most wasteful people on earth. Every day, 410,000 tons of banana peels, newspapers, automobile tires, and other items are discarded in the United States."[1] The complexity of our way of life contributes greatly to the amount of trash we produce. If we compare our way of life to a simpler one, such as that of the early American Indian, we may be able to get some ideas on how to reduce both our consumption and our waste.

SUBJECT: Social Studies, Home Economics

GRADES: 5-12

LEARNING OUTCOME: Students will identify reasons why some Americans' way of living contributes to our country's massive trash problem. Students will also identify ways to revise their way of life so as to reduce the amount of waste they produce.

LEARNING PROCEDURE:

1. Food packaging contributes greatly to America's trash problem. (Approximately 40 percent of the average American household's trash is packaging material[2])
    a. List the trash produced through the consumption of foods (cans, boxes, plastic and glass bottles, paper products, plastic bags, and organic garbage).

    b. Discuss: How did the Indians obtain food? (Hunting, gathering, fishing, farming, animal husbandry).

    c. Discuss: Did the Indians have a disposal problem? What did they do about it?

    d. Why were trash problems then different from those now?

    e. Discuss: In what ways could we incorporate or modify Indian methods in order to produce smaller amounts of trash (grow our own food and animals, use biodegradable packaging, buy more unprocessed food).

2. In our society, we use tools of all kinds from disposable razor blades to electric can openers. Once broken or worn, we often discard these items as trash.
    a. What tools or appliances have you used and thrown away in your household?

    b. What is planned obsolescence?

    c. What tools did the Indians use? (bones, bows and arrows, spears, knives, scrapers, bone awls or needles)

    d. What might we do the next time a tool or appliances is broken? (try to repair it, compare cost of repair to replacement cost)

3. When we outgrow clothing, it goes out of style, or it gets worn, we often throw it into the trash.
    a. Why would Indians have been unlikely to throw away old clothing? (hard to obtain, was resewn into something else, didn't have excess clothing)

b. What might you do to reduce clothing waste? (give outgrown clothing away, don't buy too much, repair worn clothing, buy durable clothing that is less susceptible to changes in style)

4. Can you think of items the Indians did not have which contribute to our trash problems? (cars, tires, newspapers, paper of all kinds, and plastic) Can you think of ways to reduce these kinds of trash?

5. Conclusion:

   a. Why do we produce more trash than the Indians did? (Complexity of our culture -- We don't make our own tools and clothing or directly obtain our own food. We use more manufactured and nonbiodegradable materials).

   b. What reasons can you think of for reducing waste? (reduce disposal costs, conserve energy and resources, improve the health of the environment)

   c. List some things you will do to reduce waste in your home.

PRE & POST
TEST QUESTIONS:

What is the relationship between a standard of living and the generation of solid waste?

What is planned obsolescence?

SOURCE: [1]Sands, Ken. "Garbage -- A Nationwide Problem" Spokane Spokesman Review. March 17, 1985.

[2]White, Peter T. "The Fascinating World of Trash" and Hayes, Denis. Worldwatch Paper 23. (See Bibliography for full citations).

BIBLIOGRAPHY:

Drucker, Philip. Cultures of the North Pacific Coast. New York, N.Y.: Harper and Row, 1965.

Western Regional Environmental Education Council. Project Learning Tree. The American Forest Institute, Inc., 1975.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Film: Home. Radio and TV Commission of the Southern Baptist Convention. 1972. 16 mm. 20 min. Color

TITLE: BRAINSTORMING AND LANDFILLS

RATIONALE: Organized, problem-solving techniques can be usefully applied to the problem of solid waste management.

SUBJECT: Gifted, Social Studies

GRADES: 5-12

LEARNING OUTCOME: In addressing the problem of solid waste management in the school or community, students will learn an effective problem solving technique.

LEARNING PROCEDURE:

1. The teacher will formulate a solid waste management problem to be solved by the class. For information to help formulate the problem, use the following facts and the activities "2001 - A Trash Odyssey" p. 146, "Solid Waste Survey" p. 76, and "Garbage: Its Possibilities!" p. 161. For example:

   a. In 1975, according to the New York Times, Americans threw away 134 million tons of garbage. The energy from that garbage could have been used to make:

      11.3 million tons of iron and steel
      60,000 tons of aluminum
      60 million tons of paper
      13 million tons of glass

      and was equivalent to 150 million barrels of oil.[1]

   b. Each year, Americans throw away approximately 60 billion cans, 28 billion bottles, 4 million tons of plastic, 40 million tons of paper, 100 million tires, and 3 million cars.[2]

   c. The total amount of solid waste produced per person, per year is 1,400 pounds.[3]

Plastics	51.8 lbs.	Rubber	26.6 lbs.	Paper	459.2 lbs.
Glass	138.6 lbs.	Yard	259.0 lbs.	Wood	50.4 lbs.
Food	232.4 lbs.	Metals	130.2 lbs.	Misc.	51.8 lbs.

   d. In 1982, Americans were producing 154 million tons of garbage every year -- about 1,400 pounds per person.[4]

2. Formulate your own solid waste problem for students to solve or use the following actual situation:

> On the average, each person in our county daily discards ______ pounds of garbage. (For example, Snohomish County produces about 3 pounds of mixed municipal waste per person per day.[5] All county landfills are nearly full and it is too expensive to haul garbage out of the country. What do we do? What solutions can we come up with for this problem?

Apply the following problem-solving technique to the problem:

(a) Restate the problem
(b) Determine related problems
(c) Determine the specific problem to be solved
(d) Set goals in relation to the problem
(e) Identify expert sources of information on the problem
(f) Do research and gather information
(g) Brainstorm possible solutions
(h) Establish criteria for evaluating possible solutions
(i) Evaluate solutions
(j) Determine plan of action to implement solution
(k) Present solution to others
(l) Gain acceptance and support for proposed solution.

PRE & POST
TEST QUESTIONS:

When you have a problem how do you decide on the best solution?

List steps to a problem-solving technique. Do these steps work for large community problems?

SOURCES:

[1]Rensburger, Boyce, "Coining Trash" New York Times Magazine, Dec. 7, 1975 as cited in "Recycle - Use It Again," Social Issues Resource Series, Inc. P.O. Box 2507, 8141 Glades Road, Boca Raton, Florida 33432.

[2]"Let's Recycle" EPA Office of Water and Waste Management SW-801, Washington, D.C. 1980

[3] "Do-It-Yourself Guide to: A Solid Waste Seminar." Minnesota Regional Environmental Council, Minneapolis or Quarry Hill Nature Center, 701 Silver Creek Rd. N.E., Rochestor, Minn. 55901. 1977.

[4] Moore, Dennis. "Recycling: Where are We Now?" New Shelter. February 1982, p. 56.

[5] Fitz, Allen. Solid Waste Division, Snohomish County, Everett, Washington 1985.

BIBLIOGRAPHY: Eberle and Stanish, CPS: Creative Problem Solving For Kids. D.O.K. Publishers. 71 Radcliffe Rd., Buffalo, N.Y. 14214.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE: A CAREFUL CONSUMER'S TRIP TO THE GROCERY STORE

USE WITH: Putting Your Product in a Package, p. 107, Necessary Wrappers?, p. 34, Not in My Shopping Cart!, p. 89.

RATIONALE: Careful buying is the first solution to the problem of too much solid waste. An individual's careful buying decisions can significantly reduce the volume of household waste.

SUBJECT: Home Economics, Social Studies

GRADES: 6-12

LEARNING OUTCOME: Students will understand:

1. How recycled materials are used in packaging;
2. Which natural resources are used in packaging and how these resources can be conserved through careful buying and recycling;
3. That, because approximately 40 percent of household waste consists of packaging,[1] responsible buying choices can reduce Washington's waste stream.

TEACHER BACKGROUND: The Environmental Action Foundation in 1974 published research showing that the energy used to produce the packaging used by McDonald's hamburgers in a year was equivalent to the amount of energy required to supply the people of Boston, Washington, San Francisco, and Pittsburgh for a year[2].

Note in your discussion that 5 to 10 percent, or more, of the price of an item is for packaging alone.[3]

"It would be nice if we could stop spending one out of every eleven dollars for packaging, most of which only ends up in landfills. Containers could be designed to hold more, occupy less space, and be reused."[4]

MATERIALS:

1. Survey 1 -- Product and Packaging Chart
2. Survey 2a and 2b -- "A Potato By Any Other Name"

LEARNING PROCEDURE:

1. Explain to students that for homework they will be conducting a survey of some grocery store products and packaging.

2. Review definitions of survey terms:

   ORGANIC - derived from living organisms.

   RENEWABLE RESOURCES - naturally occurring raw materials derived from an endless or cyclical source such as the sun, wind, falling water (hydroelectricity), fish, and trees. With careful management, the consumption of these resources can be approximately equal to replacement by natural or human-assisted systems.

   NONRENEWABLE RESOURCES - naturally occurring raw materials, which because of their scarcity, the great length of time required for their formation, or their rapid depletion are considered exhaustible. In other words, when they are gone, they are gone. Example: petroleum.

3. Review how to identify packaging made from recycled materials -- look for the recycling symbol. The grey paper-board used for cereal boxes is made from recycled paper.

4. Review survey forms, distribute surveys, "Product and Packaging Chart" and "A Potato by any Other Name."

5. Give assignments:

   Survey 1: Product and Packaging Chart

   1. Choose ten products and complete the Survey 1 chart for each.

   2. Choose at least two products available in a choice of packaging.

   3. By examining the products you chose, answer the following questions:

      a. Which products need special packaging to protect public health?

      b. Which product's packaging was made from recycled materials? (Look for recycling symbol).

      c. Which products could be bought in bulk or in large containers?

d. Which products could be bought in a less processed or packaged form?

e. Which product's packaging could be improved to save energy and resources and reduce waste?

Survey 2

Find as many potato products as you can, at least 12. Use the chart "A Potato By Any Other Name" as a guide. Fill in the chart on Survey 2.

NOTE: Price per pound listing can be found on shelf labels beneath products. Analyze and discuss your findings:

1. What effect does processing and packaging have on a product's cost?

2. What effect does package size have on price?

3. What effect does package size have on the amount of waste?

4. What else is added to food as it becomes more highly processed?

5. List examples of recyclable packaging.

6. List examples of products for which recyclable packaging is not even a choice.

7. List examples of packaging made from recycled materials.

8. List ways people can reduce waste and increase recycling through careful buying.

EXTENDED LEARNING: Visit a food co-op and see their solution to the problem of too much packaging.

PRE AND POST TEST QUESTION:

Approximately what percentage of the cost of packaged foods you buy goes for packaging?

How can you reduce the amount of packaging you throw away?

SOURCES:

[1]White, Peter T. "The Fascinating World of Trash." National Geographic. April 1983, Volume 163, No. 4, pp. 424-357.

[2]"The Secret Language" Seattle PI, August 29, 1976.

[3]Peterson, Christina, et al. Energy Food, and You, Secondary Guide. Seattle, WA.: Washington State Office of Environmental Education, N.W. Section, 1983.

[4]Moore, Dennis. "Recycling: Where We Are Now: New Shelter. February, 1982. p. 69.

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Fritsch, Albert, et al. Energy and Food: Energy Used in Production, Processing, Delivery and Marketing of Selected Food Items. Washington, D.C.: Center for Science in the Public Interest, June 1975.

Lerza, Catherine and Michael Jacobson, Eds. Food for People Not for Profit. New York, N.Y.: Ballantine Books, 1975.

Co-Op Handbook Collective. The Food Co-Op Handbook: How to Bypass Supermarkets to Control the Quality and Price of Your Food. Boston, Mass.: Houghton Mifflin, 1975.

Survey 1.
PRODUCT AND PACKAGING CHART

Product	Renewable Recyclable (e.g. paper)		Nonrenewable Resource (e.g. petroleum)		Is this product necessary?	Is this product available in more than one form of packaging?	If so, which is best in terms of recycling and waste reduction?	Is there an alternative to this product?	How could the packaging be improved to save resources and energy?	What happens to this product's package when the contents are used?	Will this product's packaging become part of Washington's waste stream?
	Organic (derived from living organisms)	Renewable Recyclable Packaging	Nonrenewable Recyclable Packaging	Nonrenewable Nonrecyclable Packaging							

BAKERS
CHIPS
FRIES
INSTANT
POTATO
BUDS

A POTATO BY ANY OTHER NAME

PRODUCT	PACKAGE SIZE	PRICE	PRICE PER POUND
Fresh potatoes	10 lb.	$ .98	$ .098
Fresh potatoes	2 lb.	.49	.245
Del Monte canned whole new potatoes	16 oz.	.28	.28
Bel-Air* Southern Style hashed browns	32 oz.	.59	.295
Bel-Air* Tater Treats	16 oz.	.45	.45
OreIda Tater Tots	16 oz.	.49	.49
Bel-Air* frozen french fries	9 oz.	.28	.496
OreIda dinner fries	24 oz.	.77	.51
OreIda frozen shoestring potatoes	12 oz.	.45	.60
Idahoan instant mash potatoes	8 oz.	.37	.74
Pillsbury artificially flavored mashed potatoes	16 oz.	.85	.85
Butterfield shoestring potatoes	16 oz.	1.19	1.19
Betty Crocker potato buds	5 oz.	.41	1.31
Granny Goose potato chips	8 oz.	.75	1.50
French's potato pancakes	6 oz.	.57	1.52
Small order McDonald's french fries	3 oz.	.32	1.69
Betty Crocker AuGratin potatoes	5.5 oz.	.59	1.71
Procter and Gamble's Pringles	4.5 oz.	.49	1.72
Nabisco potato snacks	5 oz.	.62	1.98
Nabisco tater puffs	5 oz.	.64	2.05
Granny Goose potato chip packets (½ oz. @)	6 oz.	.95	2.52

*Bel-Air is Safeway Stores, Inc. private label. All items priced on July 13, 1976, at Safeway Stores and McDonald's in San Francisco.

From: The AgBiz Tiller, August 1976.

Survey 2

A POTATO BY ANY OTHER NAME

PRODUCT	PACKAGE SIZE	PRICE	PRICE PER POUND

TITLE: THERMODYNAMICS, LITTER, AND RESOURCE RECOVERY

USE WITH: Take a Bite of The Finite, p. 86, and How to Calculate BTU's Per Container, p. 152.

RATIONALE: The Second Law of Thermodynamics states: Without a constant input of energy, all systems and their surroundings tend toward disorder. A discussion of littering, landfills, and resource recovery can graphically illustrate this law.

SUBJECTS: Science, Social Studies

GRADES: 7-10

LEARNING OUTCOME: Students will become familiar with the Second Law of Thermodynamics which states that any system and its surroundings tend spontaneously toward a state of increasing disorder. Students will see a littered school ground and garbage that has been dumped together for transportation to the landfill as disordered systems. Students will understand that some resource recovery processes are energy- and time-intensive methods of trying to bring order to this system.

LEARNING PROCEDURE:

1. Starting with a deck of cards ordered by suit, shuffle the cards. Observe. Then shuffle again. How long will you have to shuffle until they are in order again?

2. Drop some food coloring into water. Describe what happens to it and discuss what would be necessary to reconcentrate the food coloring.

3. Scatter golf or ping pong balls from an ordered position. How much energy does it take to reorder the system?

4. Push several pieces of paper off a desk. Using time as a measurement, compare the amount of energy it takes to reorder the system.

5. As in "Take a Bite of the Finite" (p. 86), use variously colored beads to represent natural resources (aluminum, tin, petroleum, etc.) that commonly end up as solid waste. Dump beads from separate cups together to represent mixed garbage, then, using time as a measure, compare the amount of energy needed to reseparate the beads and reorder the system.

6. Either go outside or show slides of areas of your school that are badly littered. Discuss:

    a. Does it take more energy to dispose of litter properly in the first place or to reorder the system? (i.e., have custodians pick it up).

    b. Could the people who have to spend their time picking up the litter be using their time and energy more constructively?

    c. Is the amount of litter acceptable? Why is it there?

    d. What are some of the possible solutions to help with the problems of school litter?

7. When it comes to solid waste, why is a landfill a good example of a disordered system? Before the garbage ends up in the landfill, how could this "system" be reordered? (limit consumption, source separate, and recycle) Why are attempts to reorder the system after the garbage is mixed together (i.e., some resource recovery processes) much more energy-intensive and expensive than source separation?

PRE & POST
TEST QUESTIONS

Explain the second law of thermodynamics. (See glossary)

How can we limit disorder in relation to littering? Solid waste?

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1980.

Miller, G. Tyler, Jr. Replenish the Earth: A Primer in Human Ecology. Belmont, Ca: Wadsworth Publishing Co. Inc., 1972.

TITLE: PUTTING YOUR PRODUCT IN A PACKAGE

USE WITH: Not in My Shopping Cart!, p. 89, A Careful Consumer's Trip to the Grocery Store, p. 98.

RATIONALE: Packaging is the largest single component of household solid waste.[1] Many materials produced for the market place, however, need to be packaged in order to protect them during shipping. At the retail outlet, packaging serves to advertise products, identify contents, and may be required to meet regulatory standards.

SUBJECT: Consumer Education, Business, Economics, Design, Industrial Arts

GRADES: 7-12

LEARNING OUTCOME: Students will understand some of the benefits and drawbacks of packaging. By examining packaged products students will understand the function packaging plays in protecting and marketing products. Students' design of packages will reflect their awareness of the waste reduction and resource conservation consequences of packaging decisions.

MATERIALS: The packaged products listed on the work sheet.
Packaging information sheet and packaged products work sheet.
Materials for design/construction of prototype packages.

LEARNING PROCEDURE:

1. Teacher or students bring to class the products listed on the work sheet.
2. Divide students into groups. To a group, distribute all products in one category. Product categories are listed on the following "packaged products work sheet."
3. Ask students to select a product that they would like to design a new package for.
4. Discuss with students the packaging information sheet.
5. Ask students to list on the work sheet the function and design considerations they feel are important in designing the packaging of the products they are examining. Ask: Why did the producer package his product this way? How else might this product have been packaged?
6. Ask students to identify the packages which could be reused or recycled.

Ask: How can we reuse or recycle the packaging materials after we have used the products?

Ask: What will happen to the packaging we cannot reuse or recycle?

Ask: How can we as consumers reduce the 4.6 pounds of waste we, in Washington State, produce everyday?

7. Using the following "Packaging Information Sheet," have students develop design specifications for the packaging they will create. Challenge students by explaining their designs must include considerations of waste reduction, reuse, and recycling, as well as public safety, product protection, shipping weight, cost of packaging material, advertising, and public demand.

8. Ask students to identify the product they wish to design a new package for.

9. Share with students the materials you have provided for designing and making prototype packaging for their products.

10. Ask students to present drawings/prototypes to class and explain the reasoning for their design.

EXTENDED LEARNING:

1. Have students write to and send their designs/prototypes to packaging manufactures as suggestions for improvement in package design.

2. Analyzing a variety of products, measure the actual amount of the product compared to the size and shape of the product's package.

3. Invite representatives from the grocery business and the packaging industry to class to discuss packaging.

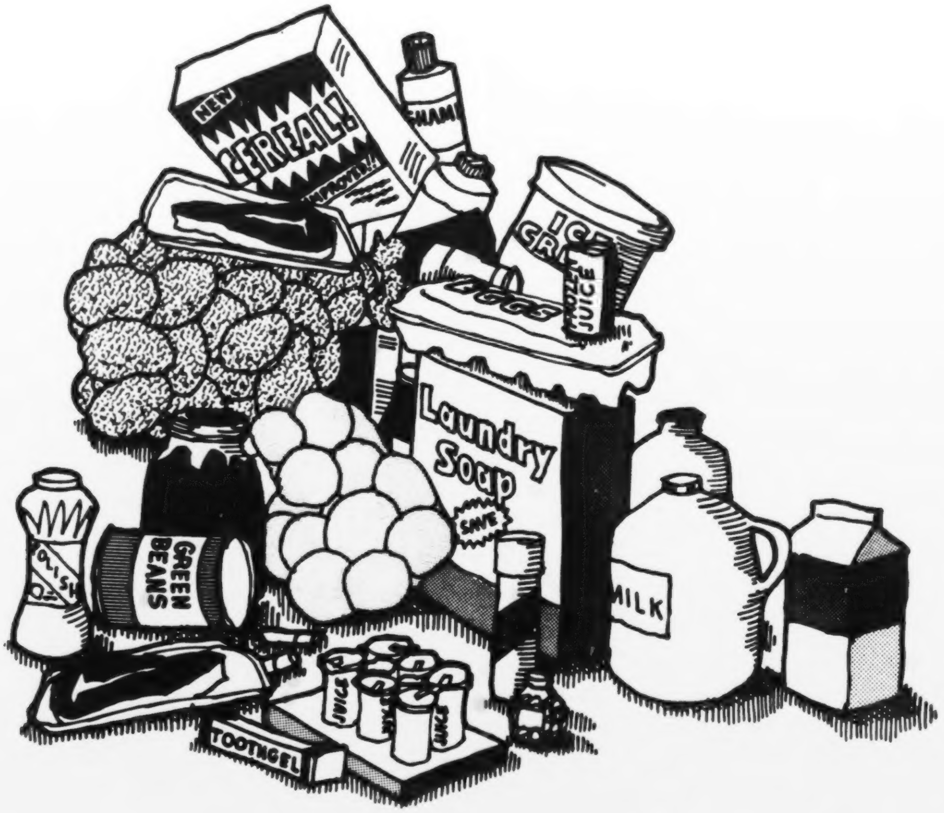
4. Research the regulatory standards packagers and retail outlets are required to meet. Ask: Who sets these standards? Why are they required?

PRE AND POST
QUESTIONS:

Why are products packaged? What are the benefits and drawbacks of packaging?

SOURCE: [1]White, Peter T. "The Fascinating World of Trash," National Geographic, April 1984, Vol. 163, No. 4, pp. 424-457.

BIBLIOGRAPHY: Packaging Council of Australia. The Benefits Of Packaging Melbourne, Australia. 1984.


NEW
CEREAL!
IMPROVED
SHAMP
ICE CREAM
JUICE
EGGS
Laundry Soap
SAVE
MILK
GREEN BEANS
POLISH
TOOTHGEL

PACKAGING INFORMATION SHEET

Consumers need to consider the role packaging plays from point of production to retail market in order to understand the importance of packaging's development, design, and function. Consumers also need to understand that packaging contributes significantly to our society's volume of waste.

Functions and benefits:

- Preservation and protection of contents
- Sanitation and safety, protection of public health
- Identification of product
- Prevention of theft
- Providing instruction as to product use
- Compliance with regulatory standards
- Manufacturing of packaging provides employment
- Increased profits

Drawbacks:

- "Roughly 40% of the American household refuse turns out to be packaging material."[1] Packaging contributes significantly to our enormous volumes of solid waste.
- Without reuse or recycling, the energy and natural resources that go into packaging are lost forever in landfills;
- Packaging contributes significantly to litter. Litter degrades the health and beauty of nature;
- Packaging may create false impressions about the amount or quality of products;
- Increased cost to consumers.

Source: [1]White, Peter T. "The Fascinating World of Trash." National Geographic, April, 1983, p.448.

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PACKAGED PRODUCTS WORK SHEET

Cosmetics/Drugs

lipstick - in paper/plastic
aspirin - in plastic jar/paper box
shampoo - in plastic bottle
tooth paste - in plastic tube/paper box

Fresh Produce

tomatoes - in paper or plastic
potatoes - in paper or plastic sacks
mixed sprouts - in plastic

Canned Foods

green beans - in tinned can
vegetables - in glass jar

Household Products

laundry soap - in recycled paperboard box
cleansing powder - in paper/metal can
furniture polish - in glass bottle

Frozen Foods

vegetables - in paper cartons
vegetables - in plastic bag
ice cream - in plastic tub
TV dinner - in aluminum tray

Dried Foods

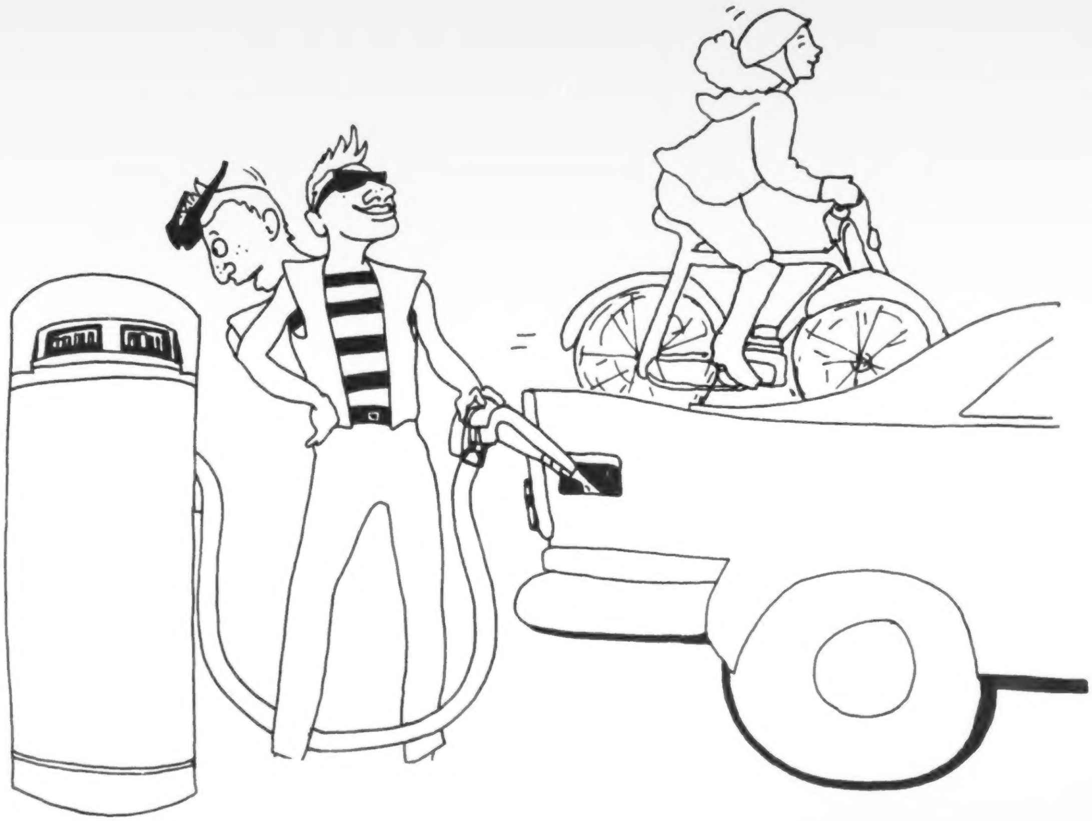
cereal - in recycled paperboard box
spaghetti - in plastic

Refrigerated Perishable Foods

fresh meat - in plastic tray/wrap
milk - plastic jug
milk - in paper cartons
eggs - in styrofoam carton
eggs - in recycled paper carton

Drink Containers

juice - in paper boxes in plastic pack
juice - in plastic six pack - aluminum/plastic serving packs
juice - in tinned cans
juice - in glass bottle or jar
juice - in aluminum can
juice - in paper/metal can



TITLE:	NATURAL RESOURCES: HANDLE WITH CARE
RATIONALE:	Examining our patterns of consumption can lead us to an understanding of which renewable and nonrenewable resources we use.
SUBJECT:	Social Studies
GRADES:	7-12
LEARNING OUTCOME:	Students will identify some of their own uses of renewable and nonrenewable resources, determine which are essential for their survival, and suggest ways they might change their lifestyles to make more careful use of natural resources.

LEARNING PROCEDURE:

Define the terms "renewable" and "nonrenewable." (Some nonrenewable resources are: petroleum, tin, aluminum, coal, copper, lead, and natural gas. Some renewable resources are: solar energy, hydroelectricity, and wood.) Ask your students to list the renewable and nonrenewable resources in products they have used or consumed in the past 24 hours, classifying each product as (1) essential for survival, (2) necessary for maintenance of their present lifestyle, or (3) a luxury. This list can be made using words and/or images. For example, students can draw pictures of each of the products they have used in the past 24 hours, accompanying these with images or words identifying each of the natural resources from which the products are made.

After looking at the lists and discussing them, students will propose alternatives for each item listed in categories two and three, making an effort to replace items which they believe are inefficient or wasteful. A master list of the resources used and the proposed alternatives can be created in the form of a display. Questions such as these might be discussed with the students:

Which, if any, items listed in the "essential" category are really not essential? What are your criteria for evaluating an item's necessity?

Which, if any, items listed in the second category are luxuries? On what basis do you judge an item a luxury?

What would be the environmental and economic impact of switching to your alternatives? Would it increase your use of renewable resources? (For example, switching from aluminum foil to wax paper would accomplish this.) Or, would it increase your use of nonrenewable resources? (Switching from paper cups to most plastic cups would have this effect.) How would changes in the production and consumption of these products influence the use of energy? How might changes in the production and consumption of these products affect the economy?

Look at the list of luxury items. Which items could you give up without a major change in your lifestyle?

Make a list, beginning with the easiest item to give up and ending with the most difficult. Could you give up the top three items on this list for a day? A week? A month? Try it.

Think of several ways to reuse or recycle items you determine you could not give up.

Identify some of the economic, cultural, and environmental repercussions of any changes you make or recommend. Consider the implications if your entire family, school, community, and nation made such changes.

PRE AND POST TEST QUESTIONS:

What makes nonrenewable resources nonrenewable?

BIBLIOGRAPHY:

Western Regional Environmental Education Council. Project Learning Tree. The American Forest Institute, Inc., 1975.

Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1980.

Little, Dennis L., Robert E. Dils and John Gray, Eds. Renewable Natural Resources: A Management Handbook for the 1980's. Boulder, Colorado: Westview Press, 1982.

Theobald, Robert. Challenges in Renewable Natural Resources: A Guide to Alternative Futures. Washington, D.C.: Department of Agriculture: Super. of Docs., U.S. Government Printing Office, 1979.

TITLE: POSTER FACTS

USE WITH: Commercials With an Environmental Message, p. 74.

RATIONALE: Consumer habits contribute to solid waste management problems and solutions. Statistics can be used to promote the "four R's."

SUBJECTS: Social Studies, Science, Math

GRADES: 7-12

LEARNING OUTCOME: Students will create posters demonstrating how consumer habits may contribute to or help solve the problem of too much solid waste. These posters will emphasize the "four R's" of solid waste management: revise, reuse, recycle, and recover.

LEARNING PROCEDURE:

1. Students research facts and statistics that relate resource and energy consumption to solid waste. Refer to the activity "Brainstorming and Landfills" (p. 95) and the following solid waste fact sheets (p. 325) for examples.

2. Students make posters promoting recycling that include a factual statement with each poster. For example: Did you know that you can make 20 recycled aluminum cans with the energy it takes to make one new aluminum can?

EXTENDED LEARNING:

1. Discuss the accuracy of some of the statistics presented on the fact sheets. Why might different sources give different statistics for the same phenomenon?

2. How are the statistics computed? How reliable is each source? Discuss the problem in dealing with large numbers. How do you make them more meaningful?

3. Have the students determine how many pounds of paper are thrown away per person each day within the class, within the school. Estimate how much energy was required to produce what was discarded. Note: Paper production requires 20,400 BTU/lb (British Thermal Unit, for definition, see Glossary) or 44.9 BTU/gm or 4,134 CAL/lb. Refer to activity "How to Calculate BTU's Per Container."

PRE & POST
TEST QUESTIONS:

How can posters be used to increase recycling in school and in the community?

List three facts about waste and recycling which can be illustrated on posters.

BIBLIOGRAPHY:

Recycling Hotline. Guide to Household Recycling. Olympia, Wa.: Washington State Department of Ecology, 1982.

SIRS Digest Study Guide: Pollution. Gaithersburg, Maryland: Social Issues Resources Series Inc., 1977.

Rackow, Leo. Postercraft. New York, N.Y.: Sterling Publishing Co., 1971.

SOLID WASTE FACT SHEET

In the United States almost one ton of solid waste per person is collected annually from residential, commercial, and institutional sources. At the present rate of disposal, about 500 new dumping locations must be found each year. Source: U.S. Department of Agriculture, Our Land and Water Resources: Current and Prospective Supplies and Uses. U.S. Government Printing Office, Washington, D.C. 1976.

The lifetime garbage of the typical American will equal at least 600 times his or her adult weight. Source: Denis Hayes, Repairs, Reuse, Recycling - First Steps Toward A Sustainable Society. Worldwatch Paper 23. The Worldwatch Institute. 1776 Massachusetts Ave. N.W., Washington, D.C. 20036, 1978.

The world is now generating between 500 million and a billion tons of solid waste per year and those figures could double every 15 years. Source: U.S. News and World Report, "Rumors of Earth's Death Are Greatly Exaggerated." May 9, 1983. p. 84.

"Americans produce 154 million tons of garbage every year -- about 1,400 pounds per person. That's enough to fill the New Orleans Superdome, top to bottom, twice a day, every day. The real problem with this is the fact that more than half of this waste is still recyclable. Estimates vary, but currently the United States appears to be recycling less than 10 percent of its municipal solid waste. This puts us way behind European countries like Denmark, which recycles an impressive 60 percent of its waste." Source: Dennis Moore, "Recycling: Where Are We Now?" New Shelter. Feb., 1982. p. 58.

Given population and the information from U.S. News and World Report and New Shelter, Americans comprise about 5 percent of the world's population and annually produce between 15 and 38 percent of the world's garbage.

The nation's 15,000 landfills occupy about 476,000 acres. Source: Peter T. White, "The Fascinating World of Trash" National Geographic Magazine April, 1983 and Denis Hayes, Worldwatch Paper 23. (Full citation above)

One thousand tons of uncompacted waste would cover a half-acre of land three feet deep. (The City of Seattle generates (1983) 1,200 to 1,300 tons of solid waste a day.) Sources: U.S. News and World Report, Washington Department of Ecology and Conrad Lee, City of Seattle, Engineering Department, Solid Waste Utility, 1983.

In the United States, in 1978, waste disposal cost approximately $4 billion a year. In many cities, expenditures for waste management were second only to those for education. Source: Denis Hayes, Worldwatch Paper 23. (Full citation above)

In Seattle, the cost of residential and commercial waste disposal has increased 55 percent in the last five years, or about a million dollars a year. In Snohomish County, the cost of waste disposal increased fivefold between 1979 and 1983. Sources: Conrad Lee, City of Seattle, Engineering Department, Solid Waste Utility and Allen Fitz, Resource Recovery Engineer, Snohomish County Department of Public Works, 1983.

Throwing away an aluminum beverage container wastes as much energy as pouring out a can half-filled with gasoline. Failing to recycle a daily edition of the Washington Post or London Times wastes just as much. Source: William U. Chandler, Materials Recycling: The Virtue of Necessity. Worldwatch Paper 56. The Worldwatch Institute, 1776 Massachusetts Ave. N.W. Washington, D.C. 20036. 1983.

If you drink two aluminum cans of beer or soft drinks per day and fail to recycle the cans, you waste more energy than is used daily by each of a billion human beings in poorer lands. Source: 1978 Family Energy Watch Calendar. ConservAction. Washington State S.P.I. and Wa. State Energy Office, Olympia, WA.

Making aluminum from recycled aluminum uses 90 to 95 percent less energy than making aluminum from bauxite ore. Source: William U. Chandler Worldwatch 56. 1983. (Full citation above)

In 1972, only 15 percent of all aluminum cans were recycled in the United States; in 1981, 54 percent were recycled. Source: Chandler, Worldwatch 56, 1983,. (Full citation above)

Making paper from recycled paper uses 30 to 55 percent less energy than making paper from trees and reduces the air pollution involved in the paper making process by 95 percent. Source: Chandler, Worldwatch 56. (Full citation above)

About 70 percent of all metal is used just once and then discarded. The remaining 30 percent is recycled. After five cycles, only one-quarter of one percent of the metal remains in circulation. Source: Denis Hayes, Worldwatch 23. 1978. (Full citation above)

Only about one-fourth of the paper, aluminum, iron, and steel used in the world is recovered for recycling. Source: Chandler, Worldwatch 56. 1983 (full citation above)

In 1982 nearly 20.3 million pounds of litter were discarded in Washington State. (Source: Daniel B. Syrek, Washington Litter. The Institute for Applied Research, Sacramento, Ca. 1983). That's 4.4 pounds of litter per person. On the bright side, in 1983, the state total had fallen to 3-3/4 pounds per person. Washington State has achieved a 10 percent reduction in litter every year since 1977. Source: Syrek, Washington Litter.

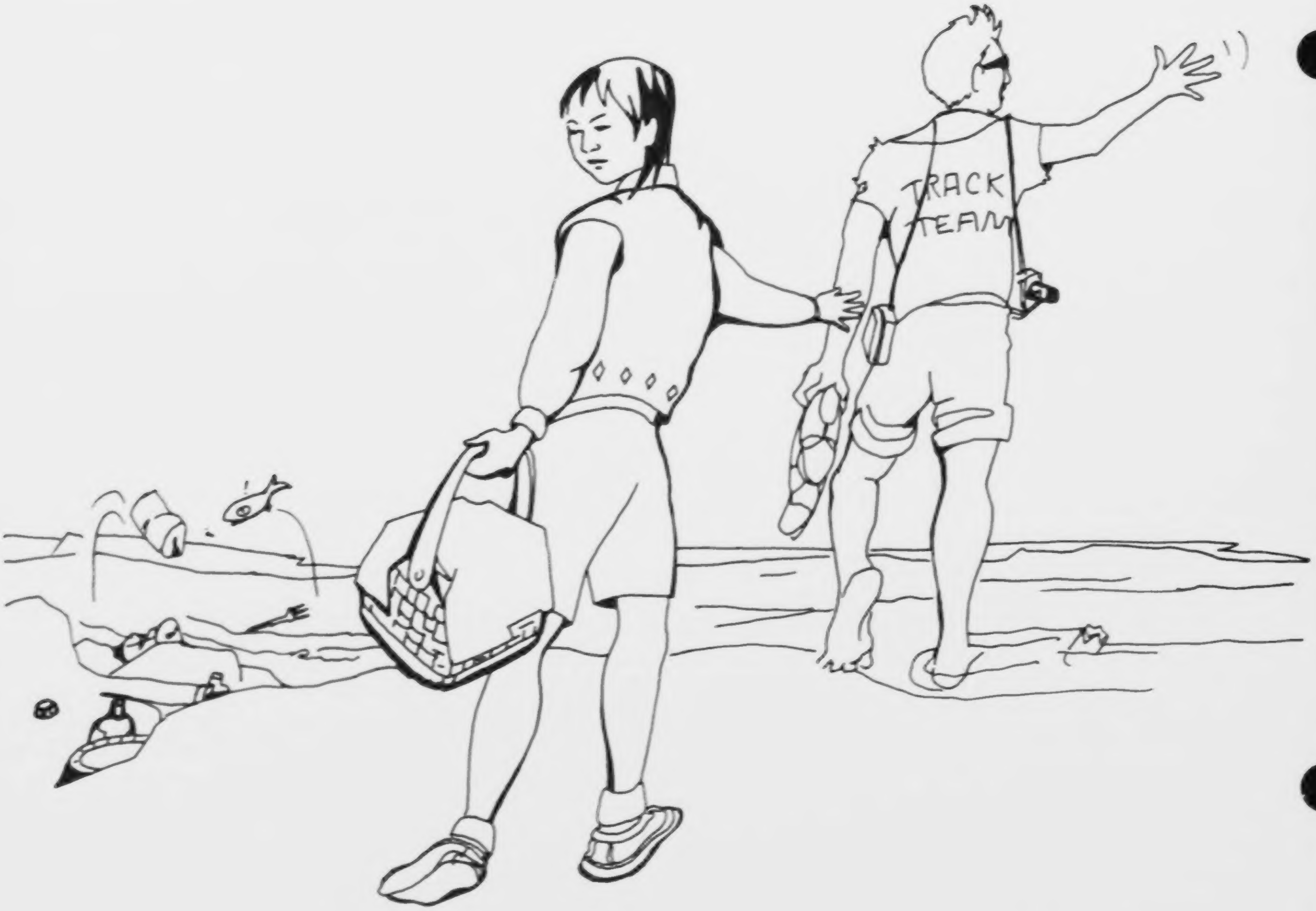
In 1982 the Washington State Model Litter Control and Recycling Act, funded by industry, spent $639,097 through the Department of Ecology's Youth Corps for litter pickup in Washington. In 1982, the Youth Corps picked up 648 tons of litter and earned over $9,000 by recycling. Source: Washington Department of Ecology, Youth Corps Program.

Washingtonians recycle nearly 400,000 tons annually. Source: Washington Department of Ecology Litter Control and Recycling Program Fact Sheet. In 1981, 10 percent of Washington's waste was recycled saving $36.5 million in disposal costs and the equivalent of 2.2 million barrels of oil in energy costs. Source: Washington Department of Ecology Recycling Hotline. 1-800-RECYCLE.

The total weight of packaging used by each of us between 1958 and 1971 increased by 44 percent -- from 404 pounds each in 1958 to 525 pounds in 1971 to a predicted 661 pounds in 1976. Source: Oregon Department of Environmental Quality. Recycling Information Office, Portland, Oregon.

Each year, Americans throw away approximately 60 billion cans, 28 billion bottles, 4 million tons of plastic, 40 million tons of paper, 100 million tires and 3 million cars. Source: Environmental Protection Agency. Office of Waste Management, Washington, D.C. 1980.

Paper, the single largest component of what we throw away, comprises 50 percent of the volume of America's solid waste. Americans each use 580 pounds of paper a year, the highest consumption in the world. In the U.S. South and East Coast regions, an "average" tree used to make pulp for printing and writing paper would probably weigh about 500 pounds. This 500 pound tree, after processing through the paper making system, would probably make about 100 to 150 pounds of paper. A typical pulp and paper mill would require approximately 27 million BTU's of energy to make a ton of paper Another way of looking at this would be to say that one gallon of "oil equivalent" would make approximately 11 pounds of paper. A typical mill would probably use in the range of 25 to 35 gallons of water to produce a pound of paper. This information suggests that each year every American uses the equivalent in paper of between 3.8 and 5.8 trees. Making one American's paper consumption of 580 pounds requires about 7,830,000 BTU's of energy and between 14,500 and 20,300 gallons of water. Sources: Dennis Moore, "Recycling: Where are We Now?" Full citation above. William U. Chandler, Worldwatch Paper 56. Full citation above. Scott Paper Company, Consumer Information Center, Scott Plaza, Philadelphia, Pennsylvania 19113.



TITLE: PICTURE THIS

USE WITH: Would You Do It If I Taught You? If I Paid You?, p. 72.

RATIONALE: Aesthetics, awareness of trash as an ugly sight, is a strong motivation to dispose of litter properly.

SUBJECT: Language Arts, Art and Photography

GRADES: 7-12

LEARNING OUTCOME: Students will appreciate at least one negative effect -- the ugliness -- of litter in their community.

TEACHER BACKGROUND

Persons convicted of littering are subject to a minimum fine of $50 and/or litter pickup time.

Litter bags are required by law in all vehicles and boats. Persons not complying with this law are subject to the $50 minimum fine.

It is illegal for a vehicle to be driven in this state with materials that are loose or falling off. Persons not complying with this law are subject to a flat fine of $108.

Call 1-800-LITTERS (toll free) to receive a complimentary litter bag or to report motorists you observe littering. Report license number, make, color of vehicle, location, date, and time.

MATERIALS: Camera; photographic developing and printing equipment

LEARNING PROCEDURE:

1. Assign students to investigate areas of unsightly litter on their way to and from school for a week. At the end of the week, discuss the various areas. Why is there a litter problem there? Are there laws against littering in Washington State?
2. In groups of two, with camera and black and white film, take photographs of these areas.
3. Develop and print enlarged pictures for a display in the school lobby.
4. Students will then write poems reacting to the pictures. Different poetic forms such as haiku, diamond poems, or cinquain, can be used. (See Bibliography for poetry writing ideas). The pictures and poems are then prominently displayed to fight littering and promote recycling.

EXTENDED LEARNING

1. Students write captions for each photo identifying the area of the community and take these photos to the local newspaper for possible use.
2. Students learn darkroom techniques for developing negatives and printing pictures.
3. Students monitor the litter problem in a given area by taking pictures over a period of time.
4. Students make a map of the community identifying areas of most litter and present their findings to City Hall.

PRE & POST TEST QUESTIONS:

Is litter a problem on our campus and in our community?

Where will most litter likely be found? Why?

What are the laws in Washington State regarding littering?

How can art and photography help solve litter problems?

BIBLIOGRAPHY:

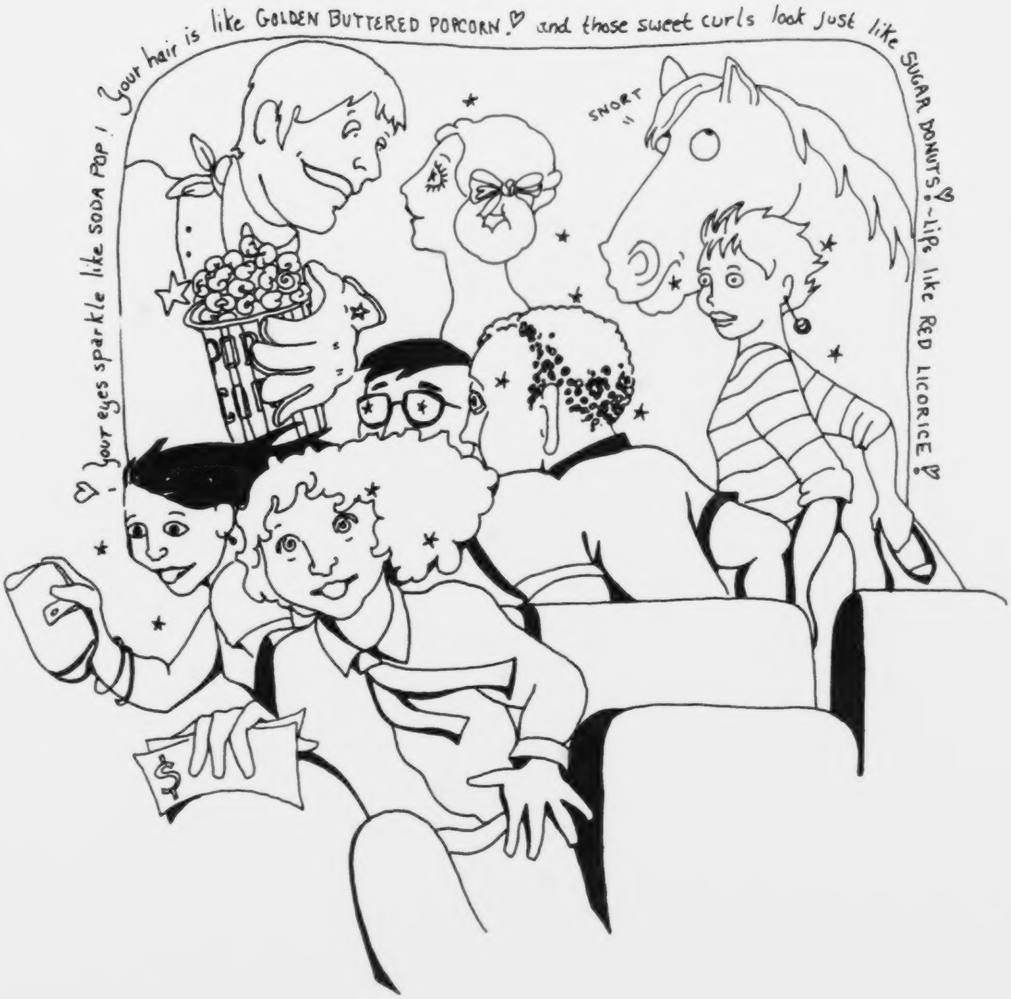
Koch, Kenneth. Wishes, Lies and Dreams: Teaching Children to Write Poetry. New York, N.Y.,: Chelsea House Publishers, 1970.

Koch, Kenneth. Rose, Where Did You Get That Red? Teaching Great Poetry to Children. New York N.Y.: Random House, 1973.

Brown, Rosellen, Ed. The Whole Word Catalogue. New York, N.Y.: Teachers and Writers Collaborative, 1972.

Eastman Kodak Company, Eds. The Joy of Photography. Reading, Mass.: Addison-Wesley Publishing Co., 1979.

RESOURCES: The Neatos and the Litterbugs in the Mystery of the Missing Ticket. Racine, Wis: Education Division, Western Publishing Co., Sandler Institutional Films, 1974.
16 mm, 6 min., color.


♡ - Your eyes sparkle like SODA POP! Your hair is like GOLDEN BUTTERED POPCORN ♡ and those sweet curls look just like SUGAR DONUTS ♡ ~ lips like RED LICORICE ♡
SNORT
POP CORN
$

TITLE:	WHAT'S THE APPEAL?
USE WITH:	Why Do I Buy It?, p. 158, and Commercials With an Environmental Message, p. 74.
RATIONALE:	Careful buying is the first solution to the problem of too much solid waste. As consumers, students should be aware of techniques advertisers use to influence buying decisions.
SUBJECTS:	Social Studies, English, Home Economics
GRADES	5-12

LEARNING OUTCOME:

1. Students will determine if recyclability and waste reduction are used as selling points in advertising.

2. Students will identify some of the influences, appeals, and techniques advertisers use to promote products.

LEARNING PROCEDURE:

1. Brainstorm various techniques used to promote products on television, radio, and in print. Bring examples from magazines to class. Examples:

   - The use of vague pronouns;
   - Sex appeal;
   - Flashy packaging;
   - Convenience;
   - "New and improved"
   - Status symbols/conspicuous consumption;
   - "Band wagon," everybody has one;
   - "Keeping up with the Joneses;"
   - Famous or glamorous people promoting product;
   - Improving self-image (by using products associated with glamorous people);
   - Symbols or repeated images;
   - etc.

2. Organize the above techniques into a chart. Have students quantify the advertising techniques used in one hour of television programming and fill in the chart.

SAMPLE CHART

(The sample chart will have these headings)

		Television	Radio	Print (magazines, newspapers)	Status	New and Improved	Convenience	Sex Appeal	Symbols	Self-Image	Famous People	Flashy Packaging	Band Wagon	Vague Pronouns	Keeping Up With the Joneses
Name of Product															

3. Make a chart that shows the results of all the surveys done by the class.

4. Have students quantify the advertising in a variety of magazines written for a range of audiences. Record results on the chart.

5. Discuss results. Ask: Which techniques are used most often? Which techniques not on our list did you identify?

   How often were recyclability, product durability, good effect on the environment, or waste reduction promoted as positive product attributes?

6. Discuss: Does advertising work; i.e., is advertising effective in getting people to buy certain products?

   Judging from your survey, are advertisers concerned about the effects their products will have on the environment?

   Are advertisers concerned about waste reduction?

   How do you think consumers would react to advertising that included product durability, recycling, and waste reduction as selling points?

PRE & POST TEST QUESTIONS:

List three techniques advertisers use to sell products.

BIBLIOGRAPHY:

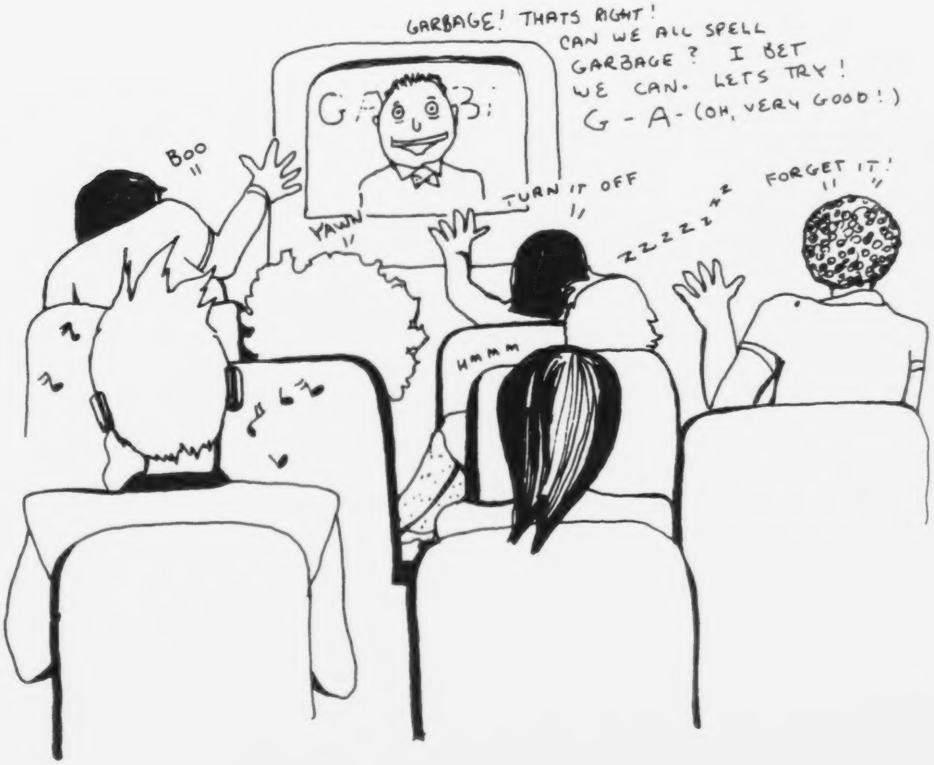
Packard, Vance. The Hidden Persuaders. New York, N.Y.: David McKay Co. Inc., 1957.

Packard, Vance. The Waste Makers. New York, N.Y.: David McKay Co. Inc., 1960.

Houlehen, Robert J. The Battle for Sales. Philadelphia, Pa.: Lippincott, 1973.

Freeman, David J., Ed. Key Social Issues for Packaging in the 1980's. New York, N.Y.: AMACOM, 1980.

Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.


GARBAGE! THATS RIGHT! CAN WE ALL SPELL GARBAGE? I BET WE CAN. LETS TRY! G - A - (OH, VERY GOOD!)
GA B
BOO
YAWN
TURN IT OFF
ZZZZZZ
FORGET IT!
HMMM

TITLE:	PUBLIC SERVICE ANNOUNCEMENTS - CAN YOU SAY IT BETTER?
USE WITH:	Commercials With an Environmental Message, p. 74.
RATIONALE:	Television public service announcements (PSA's) can effectively communicate solid waste concepts.
SUBJECT:	Language Arts, Communications, Drama, Social Studies
GRADES:	7-12
LEARNING OUTCOME:	Students will evaluate Department of Ecology PSA's to determine the qualities of an effective announcement. Students will then write and produce their own solid waste management messages in brief, informative and entertaining PSA's.
TEACHER BACKGROUND:	Public service announcements are aired free of charge by public broadcasting systems. PSA's are noncommercial, nonprofit announcements deemed important to public health and safety and community service.

MATERIALS: Department of Ecology videotapes. See pp. 343 and 344. VHS ½" video tape player/recorder and monitor.

LEARNING PROCEDURE:

1. Contact your regional Department of Ecology office to obtain the single PSA tape which includes the following PSA titles:
    a. "Look at the Mess You've Made" (Revise/Litter-30 sec.)
    b. "Discover Recycling" (Recycling-30 sec.)
    c. "Family" (Revise/Unsecured Loads-30 sec.)
    d. "Carver Nuts" (Reuse-30 sec.)
    e. "Rock" (Revise/Litter-1 minute)

2. View the PSA tape in class.

3. Analyze the effectiveness of the PSA's. Discuss:
    a. Was the message clearly communicated? What was the point of the message?
    b. To what audience was it directed? To whom was the producer of the PSA trying to appeal in featuring the characters he/she did?
    c. Was the PSA entertaining and educational or did the entertainment get in the way of the message?
    d. Was the PSA dated?
    e. Analyze the PSA's ability to change people's behavior.

4. Plan the PSA's students will produce:
    a. Have students decide what solid waste management message they want to promote for their PSA's. (Revise, reuse, recycle, recover)
    b. Think of a creative way to convey the message.
    c. Make sure the message is simple enough to be conveyed in one minute or less.

5. Write the script, prepare props, and rehearse.

6. Produce the PSA's, recording the act with a video camera, if available.

7. Make the video tape available to the rest of the school.

EXTENDED LEARNING:

1. Give awards to the group(s) that produces the most effective PSA.
2. Compare the effectiveness of a live performance versus a video performance in promoting a message.

PRE AND POST TEST QUESTIONS:

How does a public service announcement differ from a paid commercial ad on television?

What are some PSA's you remember viewing on TV? What was the message? Was this a health, safety, or community service announcement?

BIBLIOGRAPHY: "The Whys and Hows of Public Service Announcements" available from the National Citizens Committee for Broadcasting, Suite 415, 1345 Connecticut Avenue, N.W., Washington D.C. 20036.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

PSA's, Washington Department of Ecology. Public service announcements, VHS ½" tape, 3 min., color.

Department of
ECOLOGY YOUTH CORPS
Washington State
Litter Control and
Recycling Program

TITLE: THE ECOLOGY YOUTH CORPS AND YOU: GETTING A SUMMER JOB WITH THE DEPARTMENT OF ECOLOGY'S YOUTH CORPS

USE WITH: Nurture Some Nature, p. 52, Plastic Trash and Wildlife, p. 58.

RATIONALE: Careful preparation will improve a student's chance of gaining employment with the Department of Ecology Youth Corps.

SUBJECT: Career Education, Language arts

GRADE: 8-12

LEARNING OUTCOME: Students will learn how to apply for employment, particularly summer employment with the Department of Ecology Youth Corps. Students will learn how to fill out a job application. Students will learn how to prepare for a job interview.

TEACHER BACKGROUND: In 1982, the Ecology Youth Corps picked up 648 tons of litter along 8,000 miles of Washington State freeways and major highways. The program, funded by industry, cost $639,000.

LEARNING PROCEDURE:

1. To students interested in summer employment with the Department of Ecology Youth Corps, give the following information:

   The Ecology Youth Corps employs young people 14 to 17 to pick up litter and recyclables along state roadways and to promote litter control and recycling across the state. The Ecology Youth Corps is one aspect of the

Model Litter Control and Recycling Act. The act is funded by a tax on the manufacturers, wholesalers and retailers of materials contributing to litter in Washington State.

ECOLOGY
OUTH
ORPS

2. Explain that the Ecology Youth Corps will employ approximately 600 individuals in 1985, and that the current pay for Corps members is $3.35 an hour. Ecology Youth Corps crew members are hired for either July or August, and during the month, each will earn between $500 and $600. A lesser number of crew members are also hired at various times of the year to participate in special activities.

   Application forms can be obtained by calling any one of the Department of Ecology's Regional Offices. Refer to the WDOE resource page for the address of the WDOE Regional Office serving your county. (p. 343)

3. Explain that each applicant must have a Social Security number in order to be considered for employment.

4. Explain to interested students that competition for employment is stiff, with an average of 15 applications for every available job. Therefore, applications should be neatly and completely filled out in ink. For practice, fill out the following application. In addition, having interest in and knowledge about recycling and skill in meeting the public are advantages when applying for Ecology Youth Corps jobs. Interviews are required for employment and three applicants will be interviewed for each available position. Interviewers are interested in applicants who are responsible and cooperative, as shown by past employment or school activities. Good references are important.

5. Have students read the Ecology Youth Corps crew member job description and determine how their own experience prepares them for this job.

6. To prepare for a successful interview, interested students, in pairs, should practice interviewing. Have students write questions likely to be asked and then role play interviews. In summary, ask students for techniques and questions that were particularly effective, or that should be avoided. If possible, videotape and critique practice interviews using an experienced interviewer.

PRE AND POST
TEST QUESTIONS:

What are the requirements to apply for a job with the Ecology Youth Corps?

What are the duties of an Ecology Youth Corps member?

What are important considerations when filling out job applications and interviewing for employment?

RESOURCES: Contact your regional WDOE office and arrange for a representative of the Ecology Youth Corps to come to your class to present a slide show about the Ecology Youth Corps Program.

ECOLOGY YOUTH CORPS

THE WASHINGTON STATE DEPARTMENT OF ECOLOGY YOUTH CORPS
CREW MEMBER APPLICATION

The Department of Ecology Youth Corps (EYC) Program is made possible through the Model Litter Control and Recycling Act. A tax on products which commonly contribute to the litter problem is paid by businesses which manufacture or sell those items in the state.

There are several types of EYC crews. The backbone of the EYC is the litter pickup crews. These crews clean litter from highways, beaches, parks, and other recreational areas. In addition, these crews recycle many items collected during litter pickup activities. Some crews give presentations, put on puppet or magic shows, or conduct public relations projects. They also staff displays at fairs and conventions, and distribute materials such as litter bags door-to-door and at shopping malls and rest areas.

Most of the employment in the EYC occurs during July and August, but there is year-round activity. In order to qualify for most positions as an EYC crew member, you must be 14 through 17 years of age, a resident of Washington State, and willing and able to perform strenuous physical activities such as litter pickup in the hot sun, wind, or rain. A good attitude, neat appearance, and recommendations are valuable assets in your quest for employment. Previous work experience is nice, but not required. When completing your application, be sure to list work activities for which you were not paid, as well as those for which you were. Involvement in social organizations, service clubs, community projects, and volunteer experience are strong assets. Be sure to fill in all of the blanks. If you don't have any information to put in a space, then write N/A (Not Applicable), none, or simply put a dash in the space.

When you have completed your application, send it to the regional office for the county in which you are applying for work. If you are over 17, you may qualify for a position on one of the other types of crews such as a median litter pickup crew. Get in touch with the appropriate regional office.

The phone numbers and addresses of the four regional offices are provided on the reverse side of this page.

The Washington State Department of Ecology is an Equal Opportunity Employer.

Date Received ____________
(Official Use Only)

COPY

APPLICATION FOR EMPLOYMENT
CREW MEMBER
DEPARTMENT OF ECOLOGY YOUTH CORPS
Please type or print neatly in ink.

Note: Dependents of Department of Ecology employees are ineligible for employment in the Ecology Youth Corps.

NAME: ____________ (Last) ____________ (First) ____________ (M.I.)   SOCIAL SECURITY NO. ____________

DATE OF BIRTH ____________ (month) (day) (yr)   PHONE (____) ____________   MESSAGE (____) ____________

ADDRESS ____________   CITY ____________   STATE ____________   ZIP ____________

DATES AVAILABLE FOR EMPLOYMENT: FROM ____________   TO ____________

The Department of Ecology requires Youth Corps members to be Washington State residents.
Have you resided in the state of Washington for the last thirty days? Yes ___ No ___

EDUCATION

NAME OF HIGH SCHOOL AND LOCATION ____________

HIGHEST GRADE COMPLETED ____________

EMPLOYMENT List in order, Present or Last Position first.

1. Last or Present Employer: ____________   FROM (Month, Year) ____________

Position: ____________   Telephone No. ____________   TO (Month, Year) ____________

SPECIFIC DUTIES: ____________   Immediate Supervisor ____________

____

____

2. Employer: ____________   FROM (Month, Year) ____________

Position: ____________   Telephone No. ____________   TO (Month, Year) ____________

SPECIFIC DUTIES: ____________   Immediate Supervisor ____________

____

____

If you have skills or experience gained through volunteer work, community projects, or service organizations, please describe here. Give dates and nature of project or organization.

____

____

____

DO NOT DETACH

- -

AFFIRMATIVE ACTION INFORMATION - In order to ensure equal employment opportunity, the Washington State Department of Ecology, as part of its Affirmative Action Program, requests your voluntary cooperation by indicating the following. Your answers will be treated as confidential.

____
NAME (Last) (First) (Initial)

____
Soc. Sec. Number   Date of Birth   Sex
Male   Female

____
Handicapped   Describe Handicap (Complete Reverse Side)
Yes   No   Physical   Mental   Sensory

RACE/ETHNIC ORIGIN (CIRCLE ONE)

A American Indian   W Caucasian
C Asian   H Hispanic
B Black   Other ____________

SPECIAL SKILLS OR CAPABILITIES THAT MIGHT RELATE TO THIS JOB

HOBBIES, INTERESTS, SCHOOL ACTIVITIES, ETC.

IN AN EMERGENCY CALL

NAME ______ PHONE ______

ADDRESS ______
City State Zip Code

RELATIONSHIP ______

REFERENCES - Do not list former supervisors or relatives.

	Name	Relationship	Address	Phone Number
1.				
2.				
3.				

I certify that the information which has been provided on this application is true and complete to the best of my knowledge. I understand that any false or misleading information may result in the rejection of my application or my termination if employed.

SIGNATURE (in ink) ______ DATE ______

DO NOT DETACH

HANDICAPPED: YES___ NO___ (See reverse)

Briefly describe the nature and extent of your handicap:

TITLE: SOLID WASTE: WHAT'S MY RESPONSIBILITY?

USE WITH: The Goodness of Your Heart vs. the Bottom Line, p. 244, and Would You Do It If I Taught You? If I Paid You?, p. 72.

RATIONALE: People often feel powerless to do anything about enormous economic, political, or social problems. Solid waste is an example of an issue where personal action toward a solution may seem insignificant. But even if individual action by itself cannot solve these large problems, it can be the basis for a positive, personally enriching way of living.

SUBJECT: Government, Contemporary Problems, Psychology, Ethics

GRADES: 9-12

LEARNING OUTCOME: By using solid waste as an example, students will examine how their perception of a problem affects their response to that problem. Students will examine the individual's and government's responsibility in solving social problems and will define ways they, acting as individuals or in a group, can take responsibility for solutions.

LEARNING PROCEDURE:

Part I: PERSONAL RESPONSIBILITY AND SOLID WASTE

1. Have students read the following article, "My Twenty Foot Swath," p. 138.

2. Ask students questions about the man in the article:

   a. What worries this man?
   b. What does he try to do about it?
   c. Does he think his response is effective?
   d. What response do you make when faced with a problem of this kind?
   e. What is RAO? Have you ever felt RAO? In relation to what?

3. Use the problem of solid waste as an example of an area where RAO may have occurred for some people. Have students consider the following facts.

a. The world is now generating between 500 million and a billion tons of solid waste each year and those figures could double every 15 years.[1]

b. The nation's 18,500 disposal sites occupy 500,000 acres.[2]

c. A thousand tons of uncompacted waste would cover a half-acre of land three feet deep.[3] (The City of Seattle generates 1,200 to 1,300 tons of solid waste a day.)[4]

RAO is a likely response to a problem of this size.

4. Discuss the possible solutions to the problem of waste.

Ask: Who, ultimately, is responsible for solving our solid waste problems -- county, state, or federal government, those we elect, only those who generate the waste, you?

a. Should government strictly regulate disposal of all types of household waste? Should government force people to recycle? Could these regulations be enforced? Would this be "Big Brother" or a necessary step to maintain our resources and environment?

b. Is it reasonable to expect that individual action has a chance of solving a problem of this size?

c. If not, what do you see happening? More and more land used for landfills? Massive contamination problems caused by these landfills? Increased ocean dumping? More resource recovery plants? Use of technology in a yet undiscovered way of handling waste?

Part II: OTHER LARGE ISSUES AND PERSONAL RESPONSIBILITY

1. Ask students to identify other large economic/political/social issues they perceive they can do nothing about. Some examples might be:

a. Nuclear war
b. Hunger
c. Industrial pollution
d. Overpopulation
e. Unemployment
f. Inflation

2. Have students pick one of these topics or pick one you are currently studying, and list all possible solutions. Identify individual responses that can help solve this problem. Ask:

    a. How do individual solutions differ from large organized solutions (i.e. governmental or institutional efforts)?

    b. How do the benefits differ? Is there any good to be realized from an individual action even when it won't be sufficient to solve the problem?

3. What is the law's role in determining individual response to the problems? Can you think of any laws that demand or encourage personal or corporate responsibility?

    a. What legal problems might result from a law requiring people to aid accident or rape victims. (The "Good Samaritan" law in Washington State states you cannot be held liable for civil damages for any action taken in good faith and not for compensation while trying to assist at the scene of an accident.)

    b. The manufacturers of Agent Orange, the defoliant used in the Vietnam War, were sued to establish responsibility for the alleged subsequent health effects of dioxin on veterans. Should the manufacturers have been held liable? (According to law, the federal government cannot be held liable for injuries sustained in war.)

    c. As a response to the enormous litter problem, do you think the Washington State law requiring litter bags in every car and a $50 minimum fine and/or litter pickup for persons convicted of littering has been effective?

    d. What responsibility do companies manufacturing hazardous waste have for its disposal? Should the government regulate disposal? What are the company's responsibilities if the wastes are discovered years later? Regulating businesses can be expensive. Who should pay for regulation -- the government (which eventually means taxpayers), the consumers who use the products, the company itself?

    e. In terms of managing solid waste, should the state attempt to regulate behavior by laws such as the "Bottle Bill," which attempt to promote recycling by imposing a mandatory surcharge on all beverage containers?

    f. Should counties and cities enact "flow control" laws that strictly regulate disposal of waste? (Flow control measures are enacted to ensure a steady stream of waste to burn in resource recovery plants).

4. Ask students to think of a large local problem about which they feel -- "I really should do something about this." (e.g., your reaction to seeing hungry or homeless people in your city).

5. Did students do anything about the problem? Why? or Why not? If not, what keeps people from being the solution -- what keeps them from taking that final step of action?

6. Are there any community problems you have helped resolve, even in the smallest way? If you have, what problems were solved? What benefits did you derive from participating in the solution (i.e. made friends, learned something, opened door for employment, gained satisfaction in doing something worthwhile, learned to approach problems in a positive, active way)? Compare your feeling of accomplishment to that of the man in "My Twenty Foot Swath"?

Part III: A PERSONAL RESPONSIBILITY ACTIVITY

1. Have the class identify a waste, litter or recycling problem as the man in the article did, and determine what to do about it. The solutions may or may not be immediately obvious. Individual action you can take right now:

    a. Start source separation and recycling at home.
    b. Be a responsible buyer. Look for products packaged in reusable and recyclable containers.
    c. Compost waste.
    d. Speak up against litter! Report litter to hotline, 1-800-LITTERS (Refer to Activity "Litter, Litter Everywhere" p. 45 (teacher background) for more information.

My Twenty Foot Swath
Kenneth V. Lundberg
Covenant Companion
Reprinted by permission of the Covenant Press

"I worried so much about world hunger today, that I went home and ate five cookies." Did personal or global problems ever become so overwhelming that you were immobilized, or driven to some action that actually aggravated the problem? Have you experienced such frustration about the hopelessness of solving the problems of poverty, environmental pollution, or human suffering that you could avoid it only by deciding that you were powerless to do anything about their alleviation? This is called Responsibility Assumption Overload (RAO). Here's how I dealt with this feeling.

I park my car away from my building at work. That way I get both exercise and a parking space, as everyone else competes for spots next to the entrance. My morning and late afternoon strolls take me on a stretch of lawn between the tennis courts and the soccer field, and across an occasionally used softball diamond. The lawn is twenty feet wide, more or less. Soft and green, it was originally very littered. Tennis players discard tennis ball containers (and their flip-tops), worn out sweat socks, broken shoelaces and energy candy bar wrappers. Soccer game spectators leave behind beer bottles and junk food cellophane.

In my early days it disgusted me, and my thoughts centered on ways of correcting the situation: writing letters to the campus newspaper (no doubt totally ignored); campaigning for anti-litter regulations (who would enforce them?); organizing a "Zap-Day" cleanup (leaving 364 days for littering). All my noble efforts would have demonstrated my indignation, raised my blood pressure, and attracted attention, but they would not have changed the appearance and/or condition of the area.

So, I decided to take ownership. I would be the solution. I did not tell anyone of this; it was probably against some rule or another. I decided that I would be responsible for the environmental quality of this twenty-foot swath. I did not care what other parts of the campus were like. They were someone else's problem. But each day, going from and to my car, I picked up litter.

At first, it was as much as I could conveniently carry. Then I made a game of it, limiting my picking to ten items each way. It was an exciting day when I realized I was picking faster than "they" were littering. Finally, the great day arrived when I looked back on my twenty feet of lawn - now perfectly clean.

Where did I put the litter? At first, I brought it into a wastebasket in the building, or took it to the car to bring home. Then a curious thing happened. One day, large orange barrels appeared at each end of my swath. Someone in maintenance had become my silent conspirator - periodically emptying and replacing the barrels. He, too, knew the wisdom of keeping a low profile about it all.

I've done this for several years now. Has general campus appearance changed? Not much! Have litterers stopped littering? No! Then if nothing has changed, why bother?

Here lies the secret. Something has changed. My twenty-foot swath - and me! That five minute walk is a high spot of the day. Instead of fussing and stewing and storing up negative thoughts, I begin and end my workday in a positive mood. My perspective is brighter. I can enjoy my immediate surroundings - and myself - as I pass through a very special time space.

"It is better because of me. I am better because of "it." "We" enjoy the relationship. Maybe, even, "it" looks forward with anticipation to my coming.

With a brighter outlook, I have learned a lot of things that would have gone unnoticed. For instance, I have learned that tennis players grunt a lot. There seems to be some correlation between the quality of the grunt, especially on serve, and the quality of one's game. Maybe I have discovered the secret of the game. I have also learned that soccer players curse a lot, but there does not seem to be any correlation between that ability and soccer skills. I have even learned that most soccer spectators, at least at my college, come to eat, drink, and talk - not to watch the game.

My learning - and the twenty-foot swath - does not stop at the building door. There is an important principle that follows wherever I go. I cannot solve man's inhumanity to man, but I can affirm, with a smile and a word of appreciation, those who feel burdened by the need to work at lowly jobs. I cannot right the imbalances of centuries of discrimination, but I can "lift up" someone who feels the weight of a poor self-image. I can treat women as equals without solving the problems of sex discrimination. I can seek out the social and economic litter in my own "twenty-foot swath" without demanding of myself that I "clean up the whole world."

I now practice a discipline of leaving each time-space capsule of my life a little better than when I entered it. Each personal contact, each event, each room I enter becomes a small challenge. I want to leave it improved, but more important, I am responsible to myself to be improved; and thereby, maybe - just maybe - my having been there will make life better for someone else.

I am becoming more and more disenchanted and suspicious of revolutionaries, crusaders, militants, and do-gooders. Many, if not most, seem to be more concerned about being right than being loving or effectual. The zealot, no matter how well-intentioned, often leaves a trail of wounded people while in pursuit of the cause.

Is this all too myopic - shutting one's eyes to the greater concerns? It does not need to be! I now have a twenty-foot swath. Next year it may be forty, or sixty, or eighty feet wide. Ten talents were not required of him who had been given only one. Too many people stumble by taking on causes too great for their level of discernment and discipline. They need to begin to catch the vision of the important promise, that the meek shall inherit the earth, not the indignant or frustrated.

PRE & POST
TEST QUESTIONS:

List two things individuals can do to help solve problems of solid waste.

BIBLIOGRAPHY: Lundberg, Kenneth V. "My Twenty Foot Swath," Covenant Companion. Evangelical Covenant Church of America. Covenant Press, 5101 N. Francisco Ave., Chicago, Il. October '82, pp. 8-9.

SOURCES:

[1]"Rumors of Earth's Death Are Greatly Exaggerated." U.S. News and World Report, May 9, 1983, p. 14.

[2]"Let's Recycle" EPA Office of Water and Solid Waste, SW-801 Washington, D.C. 1980.

[3]John Conroy, Washington Department of Ecology, N.W. Regional Office, Redmond, Wa. 1983.

[4]Conrad Lee, City of Seattle, Engineering Department, Solid Waste Utility, 1983.

TITLE: DECIDING WHERE IT'S GOING TO GO: A Simulation of a Landfill Siting/Solid Waste Management Hearing.

USE WITH: 2001: A Trash Odyssey, p. 146, and Brainstorming and Landfills, p. 95.

RATIONALE: Management of solid waste in general and siting a landfill in particular are complex and controversial public decisions. In the decision-making process, a wide range of perspectives and values come into play.

The decision-making process used in managing solid waste is illustrative of the process used to decide other difficult public issues.

SUBJECT: Civics, Government, Contemporary Problems, Environmental Studies.

GRADES: 10-12

LEARNING OUTCOME: Students will understand the complexity of managing solid waste. Students will realize the wide range of perspectives and values involved in making decisions about solid waste.

LEARNING PROCEDURES: The class will conduct a simulated landfill siting/solid waste management hearing with class members taking the parts (outlined below) of various waste management decision makers.

1. Give the class the following problem that actually closely parallels the situation in a number of Washington State counties.

County population is growing rapidly. The volume of solid waste produced in the county is also growing quickly. Recent federal and state regulations have outlawed open dumping, so all the old dumps have been closed. To protect human and environmental health, safeguards must be built into any new sanitary landfill but this makes them very expensive to construct. People have been attracted to live in the county because of its beautiful semirural character and thus are very sensitive about environmental degradation or property devaluation that may result from a landfill or large volume garbage burner being built nearby.

The County Public Works Department, which has responsbility for proper disposal of all municipal waste generated within the county, is increasingly concerned about the growing amount of waste and is considering both a mass burner and a new landfill. The existing landfill is filling up fast and given the long lead time needed to site and build a replacement, a decision about what to do with the waste must be made soon.

The class's job is to understand and discuss the solid waste/landfill problem and come up with solutions.

2. Show WDOE solid waste slide show. (See Resource Page, 343.)
3. Choose a student to serve as County Commissioner/Hearing Examiner. Then choose other appropriate students to fill the roles described below.
4. Have students prepare to play their roles realistically and convincingly by having them contact their real counterparts in your county. Also prepare the class by conducting the activity 2001: A Trash Odyssey, p. 146. From this research, have students add information to the parts. Encourage students to add substance and appropriate detail to their roles.
5. Conduct the hearing. Have that part of the class not playing roles serve as the County Council, both questioning the hearing participants and, in the end, reaching a decision about what to do with all that garbage.
6. After completing this activity, do Brainstorming and Landfills, p. 95.

PARTS:

RECYCLING ACTIVIST

You feel strongly that more recycling could be done in the county. You think the county should require home source separation of recyclable materials such as aluminum, glass, and newspapers and that garbage haulers should be required to provide separate pickup for recyclables. You'd like the county to institute a county-wide, per-can garbage collection fee schedule that allows as little as one pickup a month. You want the county to fund public education programs in recycling; programs both for citizens' groups and schools.

You oppose both flow control and the construction of a resource recovery, waste to energy plant. As an environmentalist, you are concerned about the effects of both landfill leachate on ground water and waste to energy plant emissions on air quality.

GARBAGE HAULER

You own a garbage collection company. Your company is licensed by the state and franchised by the county. Your prime concerns are providing good service to a rapidly growing number of customers and keeping costs down. You are also concerned about county and state regulations of your business. In recent years, more of the task of running your business has been taken up with government forms and "red tape." You are concerned about the prospect of the county telling you how to set your collection fees, how the garbage itself must be picked up, and where you have to take it once it's been collected.

SPOKESMAN, HOMEOWNERS' GROUP

You are worried that the county may be planning to build a landfill near your home. You are worried about the roadway litter you're afraid this would bring. You are also concerned about the increase in the rat, crow, seagull, and federal dog population and very worried that contaminated leachate from rainwater percolating through the landfill will contaminate your drinking water. You are angry when you think that a landfill or large volume garbage burner will drastically decrease the value of the house and land you've worked so hard to own.

COUNTY PUBLIC WORKS ENGINEER

Your county department has responsibility for disposing of all waste generated within the county. You also have responsibility for meeting federal and state regulations governing the disposal of waste. Part of your job is to design and build waste facilities such as landfills and mass burners. At the same time, you are required to ensure that these disposal facilities do not create hazards for the environment or human health. A great deal of your energy goes into selecting and evaluating possible disposal sites and advising county commissioners/council members on technical aspects of solid waste management. You are becoming alarmed at the rate of growth of the county's volume of solid waste and probably better than anyone else, realize the enormity of the county's solid waste problem. You ask yourself: "Where is all this stuff going to go?"

Lately, however, much more of your time has been taken up with public relations, dealing with the concerns and sometimes anger of citizens who question or challenge county solid waste policy or decisions.

COUNTY COMMISSIONER/COUNCIL MEMBERS

Your job is to make the final decision about how to deal with the county's growing volume of solid waste, while taking into account the needs and interests of a broad range of county citizens and businesses. You have to understand both the technical information provided you by the Public Works Engineer and the anxiety of homeowners who feel threatened by the possibility of a landfill or mass burner in their area. You try to be pragmatic and fair. You also want to get reelected to office.

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Your role in this activity is to conduct a landfill siting/solid waste management hearing by calling on and questioning the five other role players. It is also your responsibility to seek the input of other class members who are acting as county commissioners/council members or as interested citizens. It is your responsibility to conduct an orderly and productive meeting.

COUNTY CITIZEN

You lead a busy life. You like the convenience that some packaged and processed food gives you, though you are sometimes bothered by the amount of packaging left over. You know your county is growing rapidly but have been more concerned about other consequences of growth such as crime, crowded highways, and air pollution than you have been about an increase in garbage. Frankly, you'd like to throw your trash in the garbage can and forget about it. You're paying the garbage hauler and the county it's taxes to take care of it for you. You don't feel you have enough time in your day to fool around with the trash, separating it or tying it up to take to a recycler.

EXTENDED LEARNING:	Invite recyclers, recycling activists, solid waste engineers, garbage haulers, and county commissioners to your class to describe the role each plays in dealing with your county's solid waste.
RESOURCE:	Available from Washington Department of Ecology. To order, see p. 343. Solid Waste Slide Show, Washington Department of Ecology, 15 minutes, color, 1984.

TITLE: 2001: A TRASH ODYSSEY

USE WITH: Brainstorming and Landfills, p. 95, Deciding Where It's Going to Go, p. 142.

RATIONALE: Most students (and citizens) do not have a full understanding of their communities' present or future solid waste management practices.

SUBJECT: Social Studies, Science

GRADES: 9-12

LEARNING OURCOME: Students will evalute both the current solid waste disposal practices and the future solid waste disposal plans in their community.

LEARNING PROCEDURE:

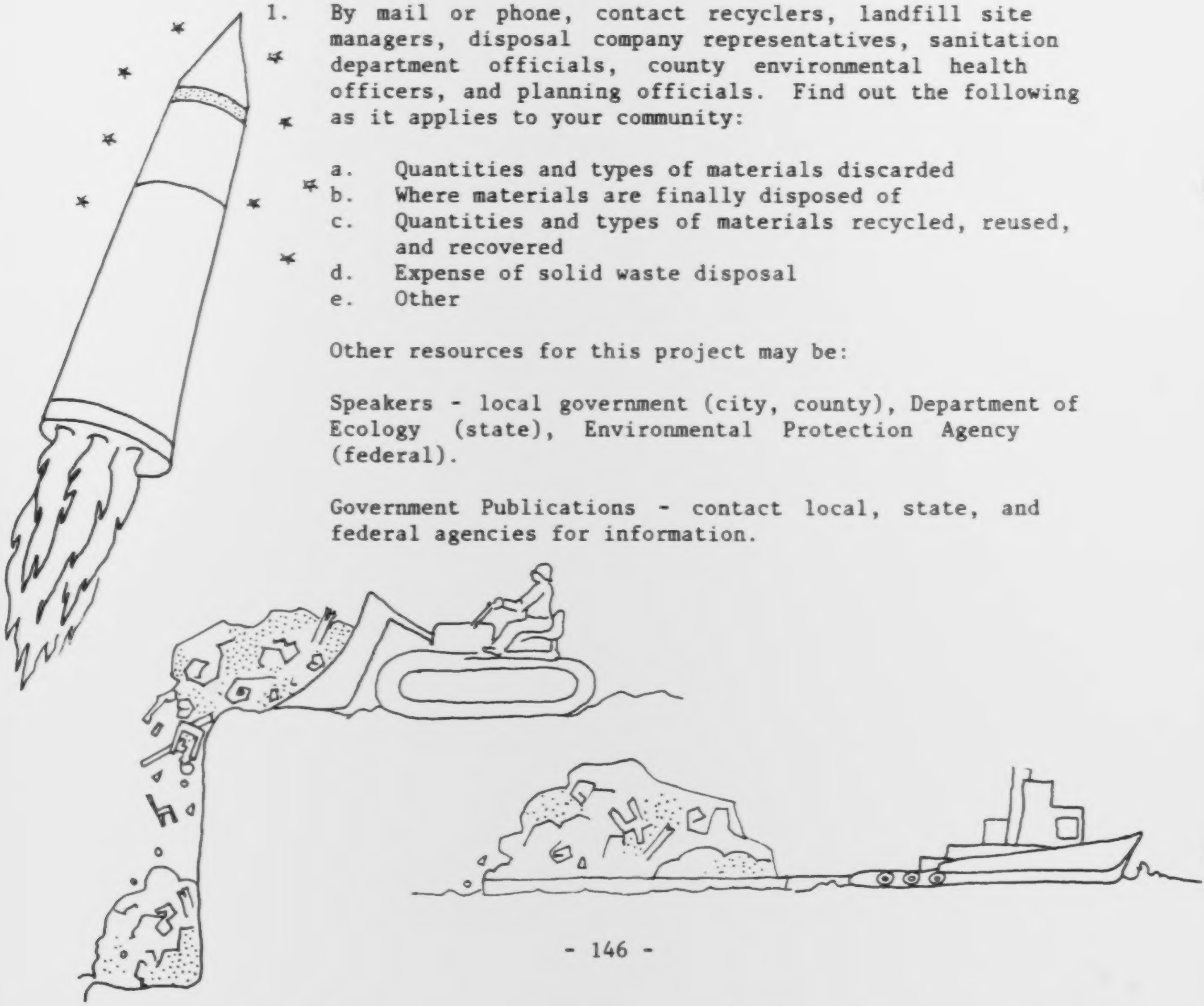
1. By mail or phone, contact recyclers, landfill site managers, disposal company representatives, sanitation department officials, county environmental health officers, and planning officials. Find out the following as it applies to your community:

    a. Quantities and types of materials discarded
    b. Where materials are finally disposed of
    c. Quantities and types of materials recycled, reused, and recovered
    d. Expense of solid waste disposal
    e. Other

    Other resources for this project may be:

    Speakers - local government (city, county), Department of Ecology (state), Environmental Protection Agency (federal).

    Government Publications - contact local, state, and federal agencies for information.



2. Determine your community's plans for future solid waste disposal by asking:

   a. How and where will solid waste be handled/disposed of in the future (landfills, energy production, recycling, etc.)?

   b. How will future disposal sites be chosen?

   c. What quantities of solid wastes will be generated in the future (more or less than present)?

   d. What will happen to the cost of solid waste disposal in the future?

3. Evaluate your findings regarding your community's plans for solid waste disposal?

   a. From your perceptions of the solid waste disposal situation, at the present and in the future, do you feel that your community has made adequate preparations for the future?

   b. If you had the ability to change any aspects of the plan for future solid waste disposal in your community, what would you do?

   c. From your research, make recommendations on how individuals in your community might become involved in determining future courses of action regarding solid waste disposal.

   d. What individual action might you take to alleviate the problem of solid waste in your community?

PRE AND POST TEST QUESTIONS:

Where does your waste material go for disposal?

What is the cost of disposal for your household?

How much does your city/county pay for disposal, including pickup, hauling, and landfilling?

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1980.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Garbage, Educational Media, 1969, 16 mm., 10 min., color.

TITLE: GNP(P): GREAT NEW PURCHASING POWER

USE WITH: Take a Bite of the Finite, p. 86.

RATIONALE: Economic success encourages an increased level of energy consumption.

SUBJECTS: Math, Social Studies, Economics

GRADES: 9-12

LEARNING OUTCOME: Students will examine the relationship between Gross National Product (GNP) (for definition, see Glossary) per capita and energy consumption per capita. Students will examine what factors encourage a high level of energy consumption and will understand that recycling conserves energy.

LEARNING PROCEDURE:

1. Read the following quotes to students: "If you drink two cans (aluminum) of beer or soft drinks per day and fail to recycle the cans, you waste more energy than is used daily by each of a billion human beings in poorer lands."[1]

   "Throwing away an aluminum beverage container wastes as much energy as pouring out a can half-filled with gasoline.[2] Failing to recycle a daily edition of the Washington Post or London Times wastes just as much."[3]

2. Reproduce and distribute the following charts:

U.S. Environmental Benefits of Recycling[4]

	Paper	Aluminum	Iron and Steel
Energy Use Reduction	30-55%	90-95%	60-70%
Spoil and Solid Waste Reduction	130%*	100%	95%
Air Pollutoin Reduction	95%	95%	95%

* NOTE: More than a 100 percent reduction is possible because 1.3 pounds of waste paper are required to produce one pound of recycled paper. If all paper were recycled, the waste reduction, of course, would equal only 100 percent.

Country	1981 GNP/Capita (in U.S. $)	1972 Annual Energy Units* Per Capita**
Afghanistan	-	23
Argentina	2,560	1,490
Brazil	2,214	435
Burundi	235	9
Canada	11,230	7,870
Egypt	654	241
Ethiopia	142	34
France	12,130	3,314
Greece	4,540	1,240
Haiti	297	24
India	253	157
Japan	10,330	2,755
Laos	-	71
Mali	185	21
Nepal	156	8
Pakistan	349	68
Saudi Arabia	12,720	813
Sweden	14,500	5,140
Switzerland	17,150	3,015
United States	12,530	9,500
South Yemen	512	11

Chart From *Energy, Food and You*.

NOTE: A "-" indicates information not available

GNP(P): Great New Purchasing Power

*Each Energy Unit (EU) is equivalent to one ten thousandth of the energy expended by the average American in 1972. To be more specific, one EU is 34,300 British thermal units or around 10 kilowatt hours.

**More recent figures were unavailable. Therefore, an up-to-date direct correlation between GNP per capita and energy units per capita cannot be assumed.

3. Graph the data found above. From the general relationship between energy consumption and GNP/capita shown by your graph, what general statements can you make?

4. Separate the listed countries into three groups (high, medium, and low GNP/capita) at what appear to be natural dividing points. Now, looking only at the energy/capita column, divide the countries into three groups at what also appear to be natural dividing points. How close to being identical are your groups when done by GNP/capita and then energy/capita? Look at your groupings and make some

observations about the countries in each group. Consider such topics as geographic location, availability of resources, political systems, economic systems, and cultural factors.

5. On your graph you can see that Sweden, Canada, Saudi Arabia, and the United States are close in GNP/capita but have widely varying levels of energy consumption. Make some observations about why you think this discrepancy occurs. Consider their levels of industrialization, history, cultural preferences, availability of resources, political systems, and geography.

6. If greater economic success encourages greater energy consumption, what problems do you foresee for the world's developing nations? As each raises its standard of living, what are the implications? Do you think this increased energy expenditure is mandatory -- that is, is it possible to be economically successful as a country and not significantly increase energy consumption? Why and how? or Why not?

7. How can you and I conserve energy?

8. For the student who wishes to determine his own energy use in the same units used on the chart, the Life Style Index from the Center for Science in the Public Interest, 1755 F Street N.W., Washington, D.C. 20004, is an excellent pamphlet designed specifically to discover personal energy consumption.

8. To calculate the amount of energy used to produce food packaging that commonly ends up as solid waste, next do activity, "How to Calculate BTU's Per Container" p. 152. Have students calculate the energy tied up in the materials they throw away in one year. Compare this energy to annual per capita energy consumption in other countries.

PRE & POST
TEST QUESTIONS:

What country uses the most energy per person? Why?

Name three countries with a GNP of less than $300 per year. Do you think these countries have a high or low level of energy use per person? Why?

SOURCES: [1] ConservAction. 1978 Family Energy Watch Calender. Washington State Superintendent of Public Instruction and Energy Office.

[2] Yegge, John, Energy Educator formerly of Oak Ridge Associated Universities, Oak Ridge, Tennessee.

[3&4] Chandler, William U. *Materials Recycling: The Virtue of Necessity*. Worldwatch Paper 56. The Worldwatch Institute. Washington, D.C., 1983.

BIBLIOGRAPHY:

Peterson, Christina, et al. *Energy, Food and You, Secondary Guide*. Seattle, Wa. Washington State Office of Environmental Education, Northwest Section, 1980.

Makhyani, A. B. and A. J. Lichtenberg. "Energy and Well-Being," *Environment*, June, 1972, Vol. 14, pp. 11-18.

Sansom, Robert L. *The New American Dream Machine: Toward a Simpler Lifestyle in an Environmental Age*. Garden City, N.Y.: Anchor Press, 1976.

Fritsch, Albert, et al. *Life Style Index*, Center for Science in the Public Interest, 1755 F Street N.W., Washington, D.C. 20004, 1974.

Oxford Economic Atlas of the World. 4th Edition. London: Oxford Univ. Press, 1972.

"Population Data Sheet 1983" Population Reference Bureau, Washington, D.C.

TITLE: HOW TO CALCULATE BTU'S PER CONTAINER

USE WITH: You're Eating More Energy Than You Think!, p. 155, and GNP(P): Great New Purchasing Power, p. 148.

RATIONALE: Conservation of energy is as important as finding alternative sources of energy. Energy can be conserved by careful buying and by recycling.

SUBJECTS: Math, Science, Home Economics

GRADES: 10-12

LEARNING OUTCOME:

1. Students will compare the energy used for the package or container with the energy actually in the food itself.
2. Students will calculate how much energy is used to produce the food containers they bring to class.
3. Students will understand, in general terms, how much energy can be conserved by recycling packaging materials.

TEACHER BACKGROUND: The unit of heat energy used in science is the calorie (cal.), also called gram-calorie or small calorie. It is defined as the amount of heat energy needed to raise one gram of water 1° centigrade.

In nutrition, the unit of food energy is the Calorie (Cal.), also called kilogram-calorie, or great calorie. It is defined as the amount of energy needed to raise one kilogram of water 1° centigrade. It is equal to 1000 calories.

The small c, capital C difference is important. Only the nutritional calorie uses capital C.

Engineers use a different heat energy standard called the British thermal unit (BTU). It is defined as the quantity of heat required to raise the temperature one pound of water 1°F. One BTU = 252 calories.

*EXTRA NOTES: 1 pound = 454 grams
°C = 5/9 (°F - 32)
1 kilogram = 2.2 pounds

LEARNING PROCEDURE: By weighing the containers students have brought to class and using the chart below and the chart "Energy Used By Packaging Material" in the next activity ("You're Eating More Energy Than You Think!" p. 155), have students calculate the energy in BTU's used to produce the container.

Table 1[1]

Paper:	20,400 BTU/lb or 44.9 BTU/gm or 5,141 cals/lb
Glass:	7,628 BTU/lb or 16.8 BTU/gm or 1,922 cals/lb
Steel:	14,795 BTU/lb or 32.6 BTU/gm or 3,728 cals/lb
Aluminum:	98,616 BTU/lb or 217.2 BTU/gm or 24,851 cals/lb
Plastic:	18,544 BTU/lb or 40.8 BTU/gm or 4,673 cals/lb

1. Look up the Calories of the food that came in the container and compare Calories. Use a Calorie counter booklet or the USDA handbook *Nutritive Value of American Foods*. (See Bibliography)

2. Other ideas: Since aluminum is so light, students often wonder if making an aluminum can uses fewer BTU's than making a tinned steel can. Find a steel can of same size and weight. Determine if the aluminum can used fewer BTU's than the steel can.

3a. Determine how much energy is saved by buying a product in one large container rather than in several small ones: use milk cartons/jugs, cereal boxes, cans, etc.

3b. Compare nutrition received to energy needed to produce the container - 1 large versus several smaller containers.

4. By referring to the following table, determine how much energy can be conserved by recycling some types of packaging material.

Table 2:[2]

Energy Use Reduction Through Recycling	Paper	Aluminum	Iron & Steel
→	30-55%	90-95%	60-70%

PRE & POST
TEST QUESTIONS:

What does BTU stand for?

Which takes more energy to produce: an aluminum can or a tinned can?

SOURCES:

[1] Sources for Table: Data supplied to Center for Science in the Public Interest by Research Triangle Institute under EPA Contract #68-01-0791.

[2] Chandler, William U. *Materials Recycling: The Virtue of Necessity*, Worldwatch Paper 56. Worldwatch Institute, Washington, D.C. 1983. p. 9.

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.

Fritsch, Albert J., et al. Energy and Food: Energy Used in Production, Processing, Delivery and Marketing of Selected Food Items. Washington, D.C.: Center for Science in the Public Interest, June, 1975.

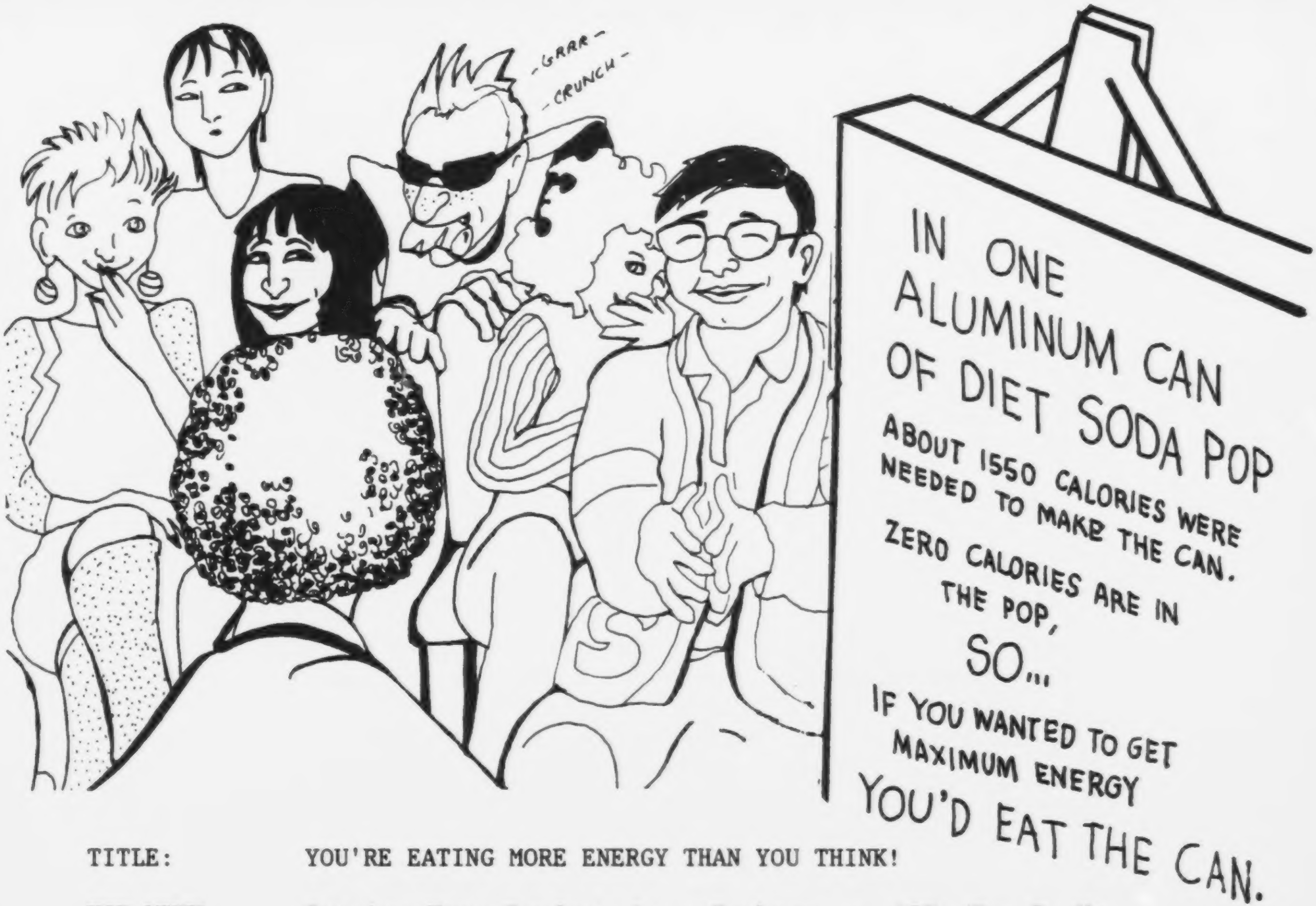
Terry, Mark and Paul Witt. Energy and Order: Or If You Can't Trust the Law Conservation of Energy, Who Can You Trust? San Francisco, Ca.: Friends of the Earth, 1976.

Bureau of Domestic Commerce. Containers and Packaging. Washington, D.C.: U.S. Department of Commerce, 1971-72.

American Paper Institute. The Statistics of Paper. New York, N.Y.: 1972.

American Iron and Steel Institute. Shipments of Steel Products. New York, N.Y.: 1972.

U.S. Department of Agriculture, Washington, D.C. (Catherine Adams) Nutritive Value of American Foods: In Common Units Agricultural Research Service, Agricultural Handbook #456 or #72, U.S. Government Printing Office.


-GRRR-
-CRUNCH-
IN ONE ALUMINUM CAN OF DIET SODA POP
ABOUT 1550 CALORIES WERE NEEDED TO MAKE THE CAN.
ZERO CALORIES ARE IN THE POP,
SO...
IF YOU WANTED TO GET MAXIMUM ENERGY
YOU'D EAT THE CAN.

TITLE:	YOU'RE EATING MORE ENERGY THAN YOU THINK!
USE WITH:	Putting Your Product in a Package, p. 107, Not In My Shopping Cart!, p. 89, A Careful Consumer's Trip to the Grocery Store, p. 98.
RATIONALE:	Every product we make or use has "hidden" energy and environmental costs.
SUBJECTS:	Home Economics, Math
GRADES:	10-12

LEARNING OUTCOME:

1. Students will understand that different forms of packaging require different amounts of energy.

2. Students will learn that foods differ in the environmental/energy impact of their containers.

TEACHER BACKGROUND: The unit of heat energy used in science is the calorie (cal.), also called gram-calorie or small calorie. It is defined as the amount of heat energy needed to raise one gram of water 1° centigrade.

In nutrition, the unit of food energy is the Calorie (Cal.), also called kilogram-calorie, or great calorie. It is defined as the amount of heat energy needed to raise one kilogram of water 1° centigrade. It is equal to 1000 calories.

The small c, capital C difference is important. Only the nutritional calorie uses capital C.

Engineers use a different heat energy standard called the British thermal unit (BTU). It is defined as the amount of energy required to raise one pound of water 1° fahrenheit. One BTU = 252 calories.

*EXTRA NOTES:
1 pound = 454 grams
°C = 5/9 (°F - 32)
1 kilogram = 2.2 pounds

LEARNING PROCEDURE:

1. Using information from the following chart, determine and compare the energy necessary to package the sample foods.
2. Fill in the price (current value) of the foods and compare the prices with the amounts of energy required.
3. Determine the types and amounts of energy required by the individual containers. Where necessary, divide the energy per pound by the correct weight of the container being examined.
4. By referring to the following table, discuss the environmental impacts of container manufacturing and disposal. Ask: What are some advantages of recycling as compared to disposal in a landfill (saves disposal costs, conserves energy, saves wasting of nonrenewable natural resources).

Table 1: U.S. Environmental Benefits of Recycling[1]

	Paper	Aluminum	Iron and Steel
		(percent)	
Energy Use Reduction	30-55	90-95	60-70
Spoil and Solid Waste Reduction	130	100	95
Air Pollution Reduction	95	95	30

PRE & POST TEST QUESTIONS:

What are some different types of packaging commonly used for your favorite foods?

Which packaging material uses the most energy to produce? least?

How can we, as careful consumers, reduce waste and the use of energy and resources, while promoting reuse and recycling?

SOURCE: [1] Chandler, William U. Worldwatch Paper 56. p. 9.

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You. Seattle, Wa.: Wa. State Office of Environmental Education, Northwest Section. Revised Edition, 1983.

Chandler, William U. Worldwatch Paper 56. (See Bibliography for full citation).

ENERGY USED BY PACKAGING MATERIALS

MATERIAL	*kcal/lb.	*kcal/oz.	*kcal/gm	BTU's/lb	BTU's/gm.
Paper	5,134	321	11.4	20,373	44.9
Glass	1,918	120	4.2	7,611	16.8
Steel	3,724	233	8.3	14,778	32.6
Aluminum	24,837	1,552	54.7	98,560	217.1
Plastic	4,670	292	10.3	18,532	40.8

Food	Amount by Weight	Energy for Container (kcal.)	Today's Price ($)
Fresh potato			
Canned potatoes			
Frozen potatoes (hashbrowns)			
Potato chips			
Dehydrated potatoes			

* kcal = 1 kilocalorie = 1 Calorie

BRIEF
QUICK-O
QUICKER
ABSOLUTELY THE QUICKEST OF ALL
JOGGERS CHOICE
RUSH-O

TITLE: WHY DO I BUY IT!

USE WITH: What's the Appeal? p. 123, Commercials With An Environmental Message, p. 74.

RATIONALE: Careful buying is the first solution to the problem of too much solid waste. Consumers should consider waste disposal and recycling when deciding what to buy.

SUBJECT: Home Economics, Communication, English, Social Studies

GRADES: 7-12

LEARNING OUTCOME:

1. Students will find out the reasons people in a grocery store buy certain food products.
2. Students will try to determine the influence of packaging on consumer choices.
3. Students will determine if consumers consider waste disposal and recycling when making buying decisions.

LEARNING PROCEDURE:

Step 1: Develop a questionnaire to use to interview people in a grocery store about the reasons they buy the items in their grocery carts.

Sample Questionnaire:

1. Which of the following factors influenced your decision to buy this product?

a. The cost per pound
b. The convenience in preparation
c. You saw it advertised
d. High nutritional value
e. Lack of artificial coloring, flavoring, or preservatives
f. The packaging is reusable/recyclable
g. Buying this because you are having company
h. Trying something new
i. Catchy packaging - visually attractive
j. A friend recommended it
k. It was on sale
l. Buying it for the kids
m. Uses less packaging than other brands
n. You're familiar with the brand
o. You've used this product before
p. etc.

Ask: Does the recyclability of the product or its package play a part in determining what you buy?

Ask: When buying, do you think of how easy or difficult the product or its package will be to dispose of when you are finished with it?

Step 2: Assign students to conduct polls for homework. Try to poll four or five shoppers and ask about six or seven items in their carts.

Step 3: Analyze and chart the results of your interviews. Which were the most common reasons for buying a food product? How often was recyclability taken into account? Were people concerned about waste disposal when deciding what to buy?

	Cost	Convenience	Advertising	Nutrition	No Artificial	Reusable/Recyclable	Company	New	Packaging	Friend	Sale	Kids	Less Packaging	Familiar Brand	Used Before
Food Product															

EXTENDED LEARNING Have students interview their own families to find out why certain products have been purchased for home use.

PRE & POST QUESTIONS:

How frequently do purchasers consider how packaging contributes to waste when shopping in the grocery store?

BIBLIOGRAPHY:

Peterson, Christina, et al. *Energy, Food and You, Elementary Guide*. Seattle, Wa.: Wa. St. Office of Environmental Education, Northwest Section, 1980.

Bradburn, Norman M. *Improving Interview Method and Questionnaire Design*. San Francisco, Ca.: Jossey-Bass, 1979.

Freeman, David J. Ed. *Key Social Issues for Packaging in the 1980's*. New York, N.Y.: AMACOM, 1980.

Darnay, Arsen & Wm. E. Franklin. *The Role of Packaging in Solid Waste Mgmt. 1966 to 1976*. Rockville, Md: U.S. Bureau of Solid Waste Management, 1969.

Shoemaker, C. *Influencing Supermarket Policies*, Nutrition Action, July 1976, pp. 3-5.

TITLE: GARBAGE: ITS POSSIBILITIES!

USE WITH: Brainstorming and Landfills, p. 95, and Deciding Where It's Going to Go, p. 142.

RATIONALE: Refuse should be considered a resource, not a liability. "Garbage is only raw material we're too stupid to use." Arthur C. Clarke

SUBJECTS: Social Studies, Language Arts

GRADES: 10-12

LEARNING OURCOME:

1. Students will investigate the solid waste management policies in their communities.

2. Students will submit a plan to the city council which includes recycling as part of the garbage collection policy.

LEARNING PROCEDURE:

Each student will do the following:

1. Research the solid waste management policy in your own community and compare it with surrounding communities. Is garbage collection mandatory? What is the cost to individual homeowners for garbage collection? Is recycling encouraged or discouraged?

2. Develop a questionnaire that will be used to interview people in the community concerning their feelings and ideas about present and future alternatives to garbage collection.

   Sample Questions:

   a. Do you know what happens to your garbage?
   b. Do you recycle?
   c. If you could get a good rate on your reduced garbage, would this motivate you to recycle?
   d. Which of the following solid waste management options do you favor in dealing with this community's solid waste:

      - recycling
      - landfills
      - resource recovery plants

   e. Do you see any other options for solid waste management in your community?

3. Interview at from 10 to 15 people in the community and graph the results.

4. Using the results of your garbage poll, write a letter to your City Council describing the feelings of the people in the community towards present garbage collection policies and some possible improvements that would include recycling.

5. Use the results of this questionnaire in planning a school recycling program.

PRE & POST TEST QUESTIONS:

What is a resource recovery plant?

How much does your family pay for garbage collection and disposal?

What happens to your family's garbage after it leaves your house?

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You. Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.

Arthur, Candice. "Checking Out Supermarkets," Nutrition Action. July 1978, pp. 3-5.

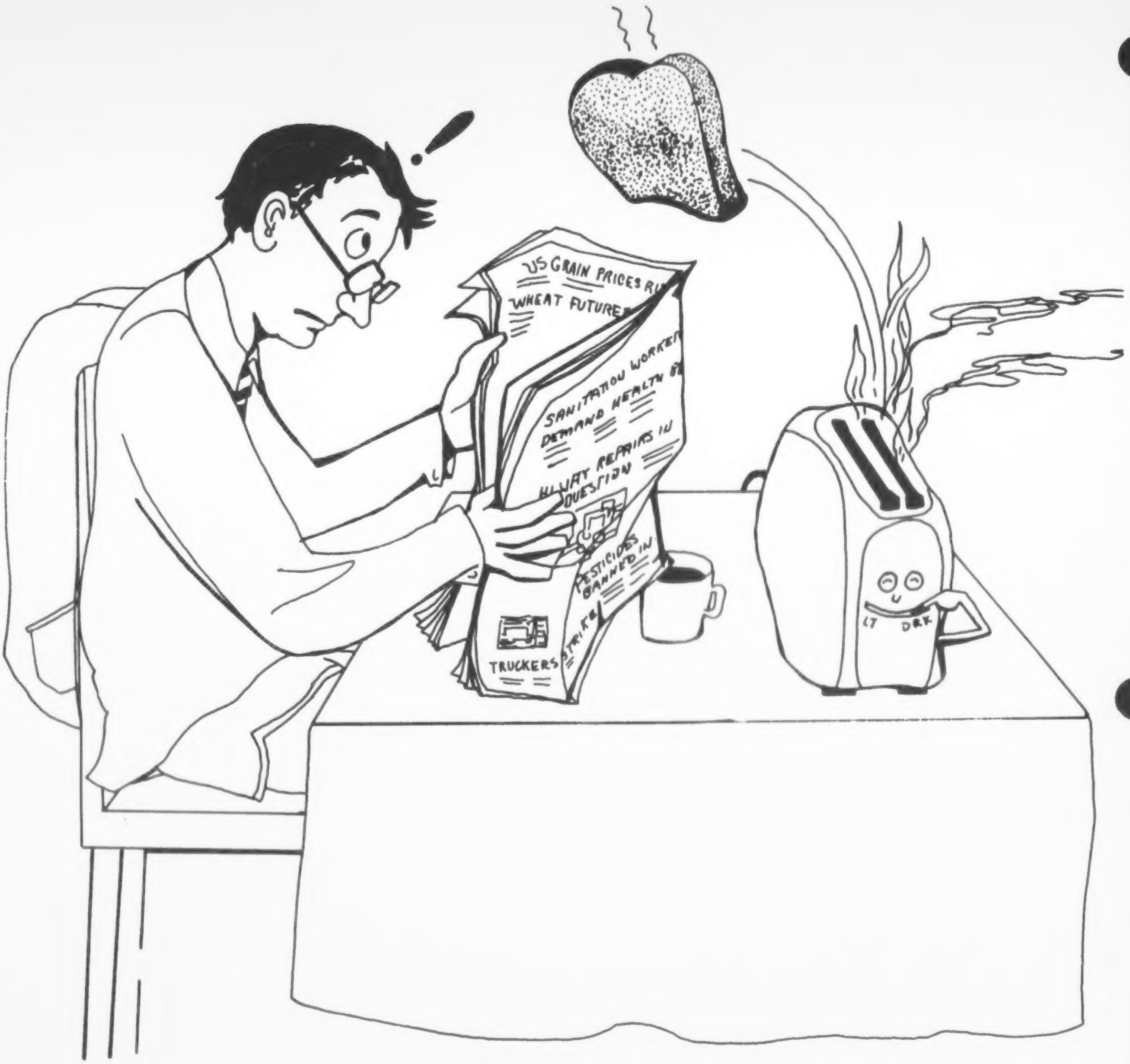
RESOURCES: For a report on one city's solid waste management policies including source separation and recycling see, Solid Waste Management II, Policy and Development Plan, available from:

Seattle Engineering Department
Solid Waste Utility
Municipal Building
600 - 4th Avenue
Seattle, WA 98104
(206) 625-2324

Available from the Washington State Department of Ecology Recycling Hotline, 1-800-RECYCLE. To order see page 343.

Washington State Department of Ecology, 1983. Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home. Olympia, Wa.

Garbage, Educational Media, 1969, 16 mm., 10 min., color.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TITLE: WHAT DOES IT COST FOR A PIECE OF TOAST?

USE WITH: You're Eating More Energy Than You Think!, p. 155, and How to Calculate BTU's Per Container, p. 152.

RATIONALE: Every product we make or use has hidden energy and environmental costs. Approximatley 15 percent, by weight, of American household waste is food waste.

SUBJECTS: Social Studies, Science

GRADES: 7-12

LEARNING
OUTCOME:

1. Students will list energy inputs in the food system.

2. Students will become familiar with the concept of net energy.

3. Students will understand that in throwing away food and food packaging they are "throwing away" energy.

TEACHER
BACKGROUND:

The unit of heat energy used in science is the calorie (cal.), also called gram-calorie or small calorie. It is defined as the amount of heat energy needed to raise one gram of water 1° centigrade.

In nutrition, the unit of food energy is the Calorie (Cal.), also called kilogram-calorie, or great calorie. It is defined as the amount of heat energy needed to raise one kilogram of water 1° centigrade. It is equal to 1000 calories.

LEARNING
PROCEDURE:

Before showing the film "Toast," ask:

1. What is an energy input? List all the energy inputs you can think of that go into making a piece of toast. Don't forget the energy that goes into the manufacture of the packaging. What are three energy inputs that go into a slice of bread before you buy it in a store? (Other activities in this guide that deal with the concept of net energy are "How to Calculate BTU's Per Container" p. 152, and "You're Eating More Energy Than You Think!" p. 155.)

2. What is an energy output? What energy output do you get from a piece of toast? What is net energy and how is it calculated? (To find net energy, subtract energy inputs from energy output.)

3. How could you increase the net energy of a slice of bread?

4. Show the film and ask students what they thought the film was trying to tell them. After showing the film, have students do the work sheet on the following page.

PRE & POST
TEST QUESTION:

Is there a way that we can, as careful consumers, obtain greater energy efficiency in the food we eat?

How can we reduce the amount of food and food packaging we throw away?

BIBLIOGRAPHY: Peterson, Christina, et al. *Energy, Food and You. Secondary Guide*. Revised Edition 1983. (See Bibliography for full citation.)

SOURCE: [1]White, Peter T., "The Fascinating World of Trash" *National Geographic*. April 1983. pp. 424-457.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Toast. Earth Chronicles, 16 mm., 1974, 12 min.

"TOAST"

Barge

Bread Truck

Car

Dough Kneader

Freight Train

Grain Silos

Grinding Mill

Harvester

Oven

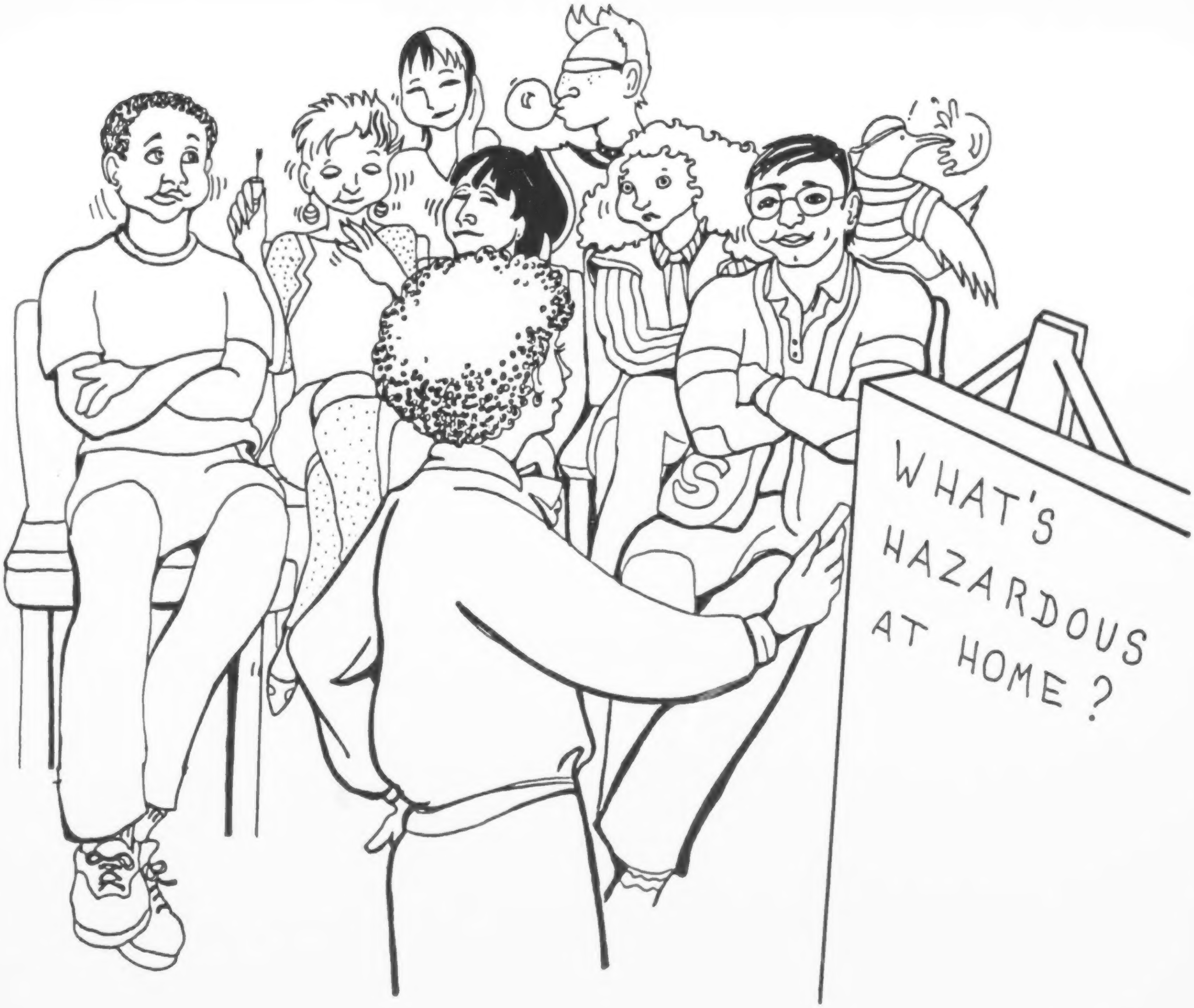
Packager

Toaster

Spreader

Automobile

1. Arrange the energy users listed above in the order in which they are used.
2. What is the form of energy that each one uses?
3. Compare the energy that goes into a piece of toast with the energy we get from it.


WHAT'S HAZARDOUS AT HOME ?
S

TITLE: WHAT'S HAZARDOUS AT HOME? or MEET MR. YUK

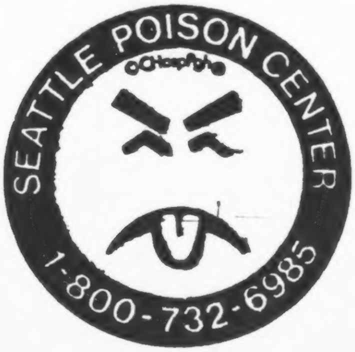
RATIONALE: Some household products may be harmful if handled improperly.

SUBJECT: Science, Social Studies, Health

GRADES: 2-6

LEARNING OUTCOME: Students will learn some common household products that may be hazardous if not used and disposed of carefully. Students will identify places in their homes where these potentially hazardous materials may likely be found. Students will learn about Mr. Yuk and how he can prevent them or their younger brothers and sisters from swallowing something harmful.

MATERIALS: Packages and labels from potentially hazardous household products (see accompanying list entitled "What's in Your House?"); Mr. Yuk stickers (available at cost from the Craft Office, Children's Orthopedic Hospital, Poison Control Center, 4800 Sandpoint Way N.E., Seattle, telephone, 526-2156. For more information about Chilren's Orthopedic Hospital's Poison Prevention Programs, call 526-5101. Mr. Yuk stickers and a poster, "Poison Proof Your Home," are available to customers from Pay-N-Save pharmacies.)



LEARNING PROCEDURE:

1. Explain to students that there are products we use at home that may be hazardous if not handled and disposed of carefully. Explain that hazardous means dangerous and that hazardous substances are likely to cause harm to the environment or to humans because they are either toxic (poisonous), flammable (quickly burnable), reactive (explosive), or corrosive (substances that rapidly eat into or dissolve away what they touch).

   Ask: Where at home might we look to find some of these products that require careful handling? Let's draw a map -- called a floor plan -- of our houses and find out.

2. Have each students draw a floor plan of his or her house and garage.

3. Project and hand out copies of the following overhead entitled, "What's in Your House?" (NOTE: This overhead and other hazardous waste activities for schools is from SLEUTH: Educational Activities on the Disposal of Household Hazardous Waste, available from Metro, Water Quality Divison, Municipality of Metropolitan Seattle.) Go over the list with students, identifying and describing the less familiar products such as antifreeze, paint strippers, varnishes, and drain cleaners. Students may be more familiar with brand names of particular products.

4. Using the previously drawn floor plans, have students write in where in their houses the listed products might be found.

5. Show students packages and labels from a number of products on the list.

   Ask: Where on a label or package can you look to find out if the product might be harmful? What will the package or label say? (Package or label may say "Danger/Poison," "Warning," "Caution" or "Keep out of the reach of children," and then will list the possible harmful effects of the product.)

   Ask: How and where should products such as these be stored? Draw an arrow on your floorplan showing where hazardous waste materials should be moved to a new location for safety.

   Ask: How can you get rid of potentially harmful products you no longer need without damaging the environment or other people? (For answers, refer to the accompanying "Product Disposal Recommendations")

   Ask: How many of you know about Mr. Yuk? When you see Mr. Yuk's scowling face, what does that mean? (Mr. Yuk is the warning symbol of Children's Orthopedic Hospital's Poison Control Center. Children should know that anything with a Mr. Yuk symbol on it is poisonous.) Draw a big Mr. Yuk symbol on the board or show Mr. Yuk stickers.

   Ask: How many of you have younger brothers and sisters? How could Mr. Yuk help if you found your little brother or sister eating or drinking something from the list we've been talking about? (By calling the Poison Control Center listed on the symbol, 526-2121, or outside the Seattle area, toll-free, 1-800-732-6985, you can find out exactly what is in any of the products so you can tell the doctor. The doctor can then prescribe the correct antidote.)

   Ask: How and where should the products on the list be stored so small children can't get them?

6. Have students take home to share with their families the marked floorplans, the list of potentially harmful household products and the information about Mr. Yuk. Ask students to put a Mr. Yuk sticker on the phone at home.

PRE & POST TEST QUESTIONS:

What are the four categories of hazardous substances?

What can you do if you have pesticides in your home that you want to dispose of?

Where should you look first to find out if a household product is potentially harmful?

When you see Mr. Yuk's face on a bottle or can, what does this mean?

What should you do if you found someone eating or drinking something harmful or poisonous?

(5th - 6th grades) What is an antidote?

BIBLIOGRAPHY: Council of State Science Supervisors. School Science Laboratories. A Guide To Some Hazardous Substances. Washington, D.C., U.S. Government Printing Office, 1984.

Dyckman, Claire, et al. Sleuth: Educational Activities on the Disposal of Household Hazardous Waste. Seattle, Washington: Toxicant Program, Report No. 10, Water Quality Division, August 1982.

RESOURCES: Western Washington Toxics Coalition, 4512 University Way N.E., Seattle, Washington 98105

ACKNOWLEDGEMENT:

Special thanks to Julie Sellick and John Conroy, Washington State Department of Ecology, for help with this activity.

PRODUCT DISPOSAL RECOMMENDATIONS:

1. General Precautions: 1. Keep all chemical wastes out of the reach of children; 2. Read the label before handling any household chemicals; and 3. Household wastes should not be mixed together, with the exceptions that brake and transmission fluid can be mixed with used motor oil.

2. Pesticides and Wood Preservatives: Pesticides should not be disposed of in the trash can or down the drain. Call your local health department district office for recommendations. In Seattle, call the Central Health Department at 587-2722, the Seattle-King County Department of Public Health Home Hazard Program at 587-4632 or Chempro Inc. at 767-0350.

3. Automobile Oil: Recycle at local gas station or call the Washington Department of Ecology's recycling hotline toll-free, 1-800-RECYCLE, for the location of the nearest oil recycler.

4. Antifreeze: Do not pour antifreeze into storm drains or sewers as these may be directly connected to streams. If a drain is connected directly to a municipal sewer system, antifreeze may be flushed down the drain with large quantities of water. (Antifreeze should not be discharged into septic tanks.)

5. Paint Solvents: When possible, reuse paint solvents by letting the paint sludge settle and reusing the solvent. If solvent is not reuseable, call Chempro, 767-0350, for recommendations.

6. Paint: Some charities accept excess paint. Rebound Program in Seattle, 324-0802, accepts paint and unopened, uncontaminated solvents. St. Vincent de Paul accepts unopened paint only.

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OVERHEAD

WHAT'S IN YOUR HOUSE?

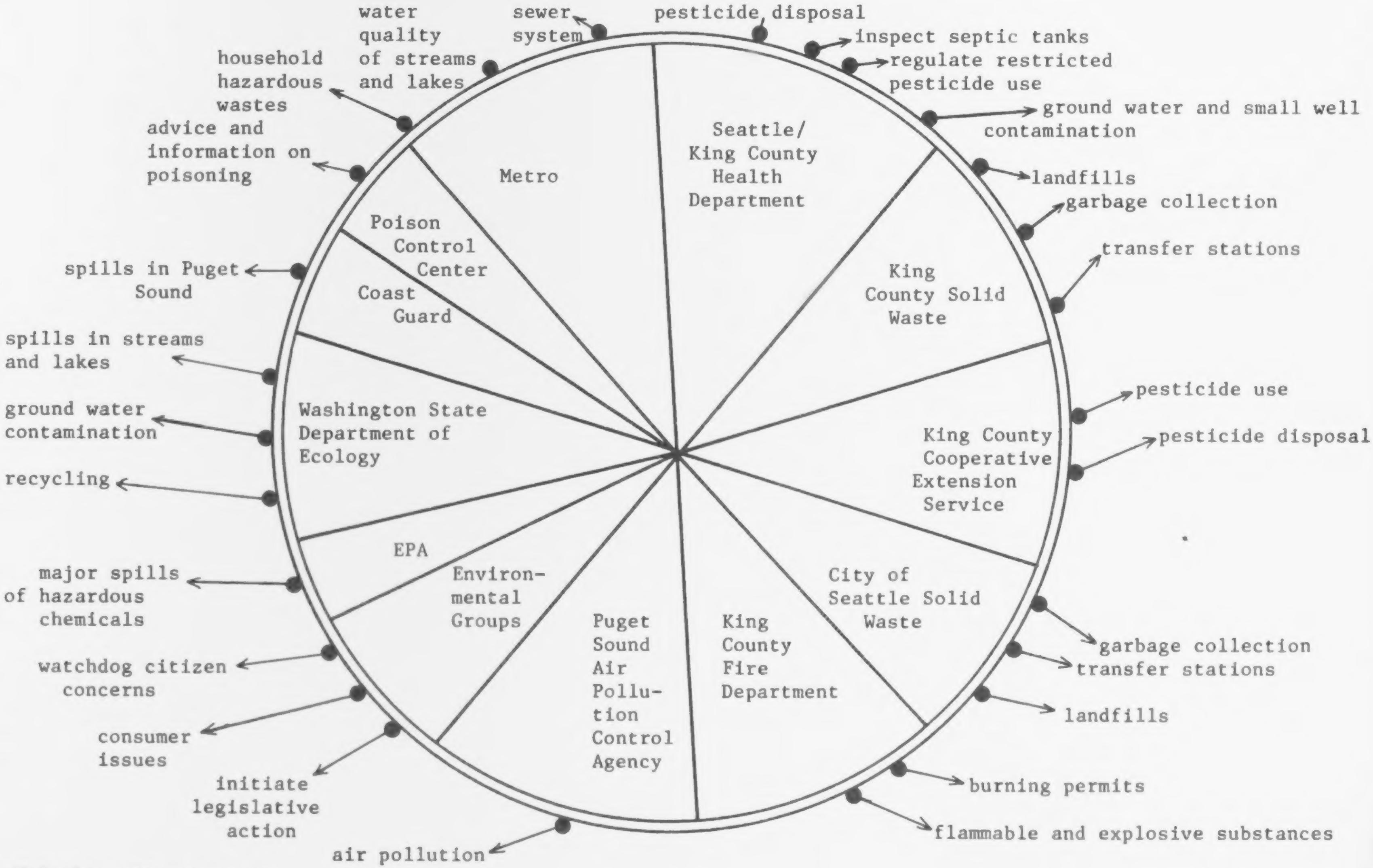
Potentially dangerous household wastes might be found in many places in the home.

All of us who use these products know how beneficial they are. But might they also harm us? or others?

PET FLEA COLLARS
TOILET BOWL CLEANERS
SLUG BAIT
LAUNDRY SOAP
WEED KILLERS
OIL
ANTIFREEZE
BREAK FLUID
LATEX PAINT
ROOM DEODORIZERS
OVEN CLEANERS
GLASS AND WINDOW CLEANERS
BATTERIES

FLOOR POLISH
ROACH SPRAY
PAINT THINNER
MILDEW PROOFING
LACQUER THINNER
WOOD PRESERVATIVES
RAT POISON
NO-PEST STRIPS
MOTHBALLS
DISINFECTANT CLEANERS
POWDERED BLEACHES
SCOURING POWDER
DRAIN OPENERS
STAINS/VARNISHES
ENAMEL PAINTS
FURNITURE POLISH
PAINT STRIPPERS

WHO IS RESPONSIBLE?


Seattle/ King County Health Department
pesticide disposal
inspect septic tanks
regulate restricted pesticide use
ground water and small well contamination
King County Solid Waste
landfills
garbage collection
transfer stations
King County Cooperative Extension Service
pesticide use
pesticide disposal
City of Seattle Solid Waste
garbage collection
transfer stations
landfills
King County Fire Department
burning permits
flammable and explosive substances
Puget Sound Air Pollution Control Agency
air pollution
Environmental Groups
initiate legislative action
consumer issues
watchdog citizen concerns
EPA
major spills of hazardous chemicals
Washington State Department of Ecology
recycling
ground water contamination
spills in streams and lakes
Coast Guard
spills in Puget Sound
Poison Control Center
advice and information on poisoning
Metro
household hazardous wastes
water quality of streams and lakes
sewer system

Use the Telephone Directory to locate phone numbers for these agencies.... (Try the Blue Pages)

SOURCE: See Bibliography. Dyckman, Claire, p. 171

TITLE: BIKES AND BY-PRODUCTS

RATIONALE: Sometimes making the things we *do* want creates things we *don't* want such as hazardous waste.

SUBJECT: Science, Social Studies

GRADES: 3-6

LEARNING OUTCOME: Students will learn what the term "hazardous waste" means and will learn some of the hazardous wastes created by the manufacturing of a bicycle.

MATERIALS: Bicycle (select a student to bring one to class)

LEARNING PROCEDURE:

1. Ask the class: How many of you have bicycles? Of what are they made? What are the frames made of? How about the tires? The handle bar grips? Where are the metal and rubber and plastic that go into bicycles made? (In mills and factories that transform raw materials such as petroleum, bauxite and iron ore into bicycle components.) Ask: What makes your bike special - different from others? How many different colors of bikes do we have? Whose bike is shiny? What is the shiny metal on bikes called? Ask: Which natural resources are used in the making of bikes? (iron, petroleum - for plastics, synthetic fibers and synthetic rubber, petroleum distillates for paint and paint solvents, bauxite for aluminum, chrome, coal for coke to smelt the iron ore into steel and others.) Ask: What had to happen to the natural resources before they could be used to build your bike? (They had to be processed in factories.) Direct the discussion from here with the aim of having students realize that when natural raw materials are processed, by-products and waste, some of which may be harmful, are produced. Ask: What are by-products? For example, what by-products are produced when you burn wood and paper in your fireplace or woodstove at home? Are some of these by-products harmful? What kinds of things might be by-products of the building of your bicycle?

2. Distribute: the manufacturers accompanying diagram of a bicycle that lists some of the materials and by-products associated with the manufacturing of bike or ask a student to bring his or her bike to class. In the latter case, have students make their own diagrams of the bike. Guide students in identifying the bike's component materials (steel, synthetic rubber, plastic, chrome, synthetic fibers, aluminum, paint, etc.) Then, by referring to the diagram, point out some of the by-products and wastes resulting from the manufacturing of these components.

3. Explain: Some (of course, not all) of the by-products and wastes from making a bike are hazardous. What does hazardous mean? (Teacher note: Hazardous means dangerous. Hazardous wastes are likely to cause harm to the environment or to humans because they are either toxic (poisonous), flammable (ignitable, highly burnable), reactive (explosive), or corrosive (substances that rapidly eat into and/or dissolve what they touch.)

   Ask: Does this mean that you will get sick from handling or riding your bike? Why not? What happened to the hazardous by-products and wastes produced when your bike was made? (NOTE: Some are captured and recycled for industrial reuse. Some are captured and disposed of in hazardous waste disposal sites such as the one in Arlington, Oregon. Some escape into the air and water such as into Tacoma's Commencement Bay, some in small quantities, are sent to conventional landfills and some are dumped illegally.)

   Ask: How should hazardous wastes and by-products be managed? Why is it important to use great care in disposing of these wastes and by-products?

   Ask: Because hazardous wastes and by-products are made when bikes are built, should we stop making bikes? What should we do that makes more sense? What are some other things you use that might also have produced hazardous by-products when they are made?

4. Discuss: Why there has been so much news about hazardous waste lately?

PRE & POST
TEST QUESTIONS:

What raw material is plastic and synthetic rubber made from?

What happens to hazardous industrial wastes?

(2nd & 3rd Grades) What is a natural resource? Name two.

ACKNOWLEDGEMENT:

Special thanks to John Conroy, Washington State Department of Ecology, for help with this activity.

BIBLIOGRAPHY: Nemerow, Nelson L., Liquid Waste of Industry. Menlo Park, Ca.: Wesley Publishing Co. 1971.

By-Product & Waste Information From

Liquid Waste of Industry,
Nelson L. Nemerow, Addison-
Wesley Pub. Co., Menlo Park,
CA, 1971

Chromed & Plated Metal Parts

Materials	By-Products & Waste
Chrome, nickel, copper, zinc.	(Highly toxic liquid wastes) Acids, chromium zinc, copper, nickel, tin, cyanides.

Handle bar grips, plastic seat cover, paint, synthetic fibers, synthetic rubber tires

Materials	By Products & Waste
Petroleum & petroleum distillates.	Waste oil from leaks, caustic & acid sludge, alkaline & acid waters, acid gases & filtering clays.

Frame & Other Metal Parts

Materials	By Products & Wastes
Iron ore & coal to make steel.	Ammonia, tar, acids (pickling liquor waste), blast furnace flue dust.

Paints & Coatings

Materials	Wastes
pigments solvents resins cleaners	paints solvents cleaners

Fenders & Other Metal Parts

Materials	By Products & Wastes
Aluminum from Bauxite.	Large volumes of "Red Mud" consisting of iron oxide, titanium & silica.

TITLE: HONEYBEES AND HAZARDOUS WASTE

USE WITH: What's Hazardous at Home, p. 169, Solid Waste: What's My Responsibility?, p. 135.

RATIONALE: Certain organisms such as honeybees gather and concentrate industrial pollutants.

SUBJECT: Science (Biology), Environmental Education, Social Studies (Government, Civics), Health.

GRADES: 6-12

LEARNING OUTCOME: Students will learn some of the hazardous substances (arsenic, lead, cadmium, and fluoride) certain industries release into the environment. Students will understand bioconcentration -- the process by which potentially hazardous chemicals build up in the bodies of certain animals. Students will learn how honeybees are used to monitor environmental pollution.

TEACHER BACKGROUND: During the study described in this activity, honey from polluted areas of Vashon Island was tested for contaminants by the Seattle-King County Health Department. No detectable arsenic or cadmium were found in the tested honey. Because of the specialized structure of their digestive systems, honeybees are able to filter contaminants from nectar, (which the bees ripen into honey). However, the same is not true for pollen. Pollutant levels in pollen samples often equal or exceed those in the tissue of bees because airborne particulates are carried back to the hives along with the pollen. Some of this pollen is then fed to larval bees (brood), which may account for poor brood survival in polluted areas.

NOTE: This activity is meant as an illustration of the kinds of problems encountered in the air pollution field. It is not meant to validate or endorse the specific research by Dr. Bromenshenk.

NOTE: The concentration of a chemical is sometimes very important in determining any health effect it may have. For example, in small concentrations, fluoride is used to retard tooth decay.

LEARNING PROCEDURE:

1. Have the class read the following articles: "Tacoma Pollution Suspected as Killer of Puget Sound Bees" by Solveig Torvik from the Seattle Post-Intelligencer of May 2, 1983, "Polluted Air: Bees Bear Bad News" by Lyn Watts of the Bellevue Journal American, and "Honey Bees as Monitors of Industrial Pollution" by Todd Peterson from the June, 1984 edition of the American Bee Journal.

Ask: Why does Dr. Bromenshenk use bees to investigate hazardous waste pollution? What do bees do that may expose them to high concentrations of hazardous substances and chemicals? In the Puget Sound region, which substances and chemicals are the bees accumulating? How are the bees affected? What other information is being given us by the bees?

Ask: What does the measurement "parts per million" mean? Project an overhead or distribute copies of the attached map showing the level of arsenic in bees at various Puget Sound locations.

Ask: Where are the arsenic concentrations in bees highest? Why might concentrations be highest here? Read the following quote from the P.I. article, "'We've seen arsenic travelling as far as Lake Washington and Lake Sammamish at fairly high levels,' Bromenshenk said. 'We're getting appreciably high levels of arsenic in South Seattle and Kent and across to Mercer Island. In these areas, the levels in bees are three parts per million, a point at which I become concerned,' he said. 'If those places haven't been examined for human health risk, they should be.'"

2. To find out why Dr. Bromenshenk might be concerned about arsenic, have students examine the following chart from a Sunday Seattle Times/P.I. article entitled, "Toxic Time Bombs are Ticking in Washington State." Explain to students that the health effects listed are acute effects from high level exposure.

Ask: What could account for the arsenic spreading so far afield? (Prevailing winds, the lift of hot gases coming out of the smelter, the great height of the smelter's smokestack, absence of adequate pollution control on the smelter stack allowing high concentrations of arsenic to escape.) Even in highly polluted areas why is the bees' honey not contaminated?

Ask: Can you think of other animals that, because of the way they live, might build up hazardous substances in their bodies? Consider oysters and explain their filter feeding. Ask: Why would oysters be particularly susceptible to hazardous waste pollution?

Ask: Are the hazardous waste materials we have been discussing difficult to control? Who has responsibility for controlling them -- the company producing them? the city where the company operates? the State Department of Ecology? the EPA?) See the following chart entitled "Who is Responsible?" Contact the Puget Sound Air Pollution Control Agency in Seattle. (See also the activity in this guide entitled "Solid Waste -- What's My Responsibility?" p. 135.)

7. Determine: If there are hazardous substances or wastes in your community. If so, what are they and who produces them?

8. Consider: Which is more important: jobs or protecting the public from the possibly adverse health effects of industrial activity? Are jobs and public health protection mutually exclusive?

EXTENDED LEARNING: Invite a local beekeeper to class to talk about bees and pesticide poisoning.

PRE & POST TEST QUESTIONS:

Why are honeybees good indicators of environmental health?

What is bioconcentration?

What does the measurement "parts per million" mean?

List three hazardous substances being released into the environment apparently by industrial activity in Tacoma. What are the threats to human health posed by these substances?

Who has responsibility for controlling the pollution of air by hazardous substances?

ACKNOWLEDGEMENT:

"Tacoma Pollution Suspected as Killer of Puget Sound Bees" reprinted by permission of the Seattle Post-Intelligencer. "Polluted Air: Bees Bear Bad News" reprinted by permission of the Bellevue Journal-American "Honeybees as Monitors of Industrial Pollution" reprinted by permission of the author and the American Bee Journal.

Special thanks to Dr. Jerry Bromenshenk and Jeane Simpson for help with this activity.

BIBLIOGRAPHY:

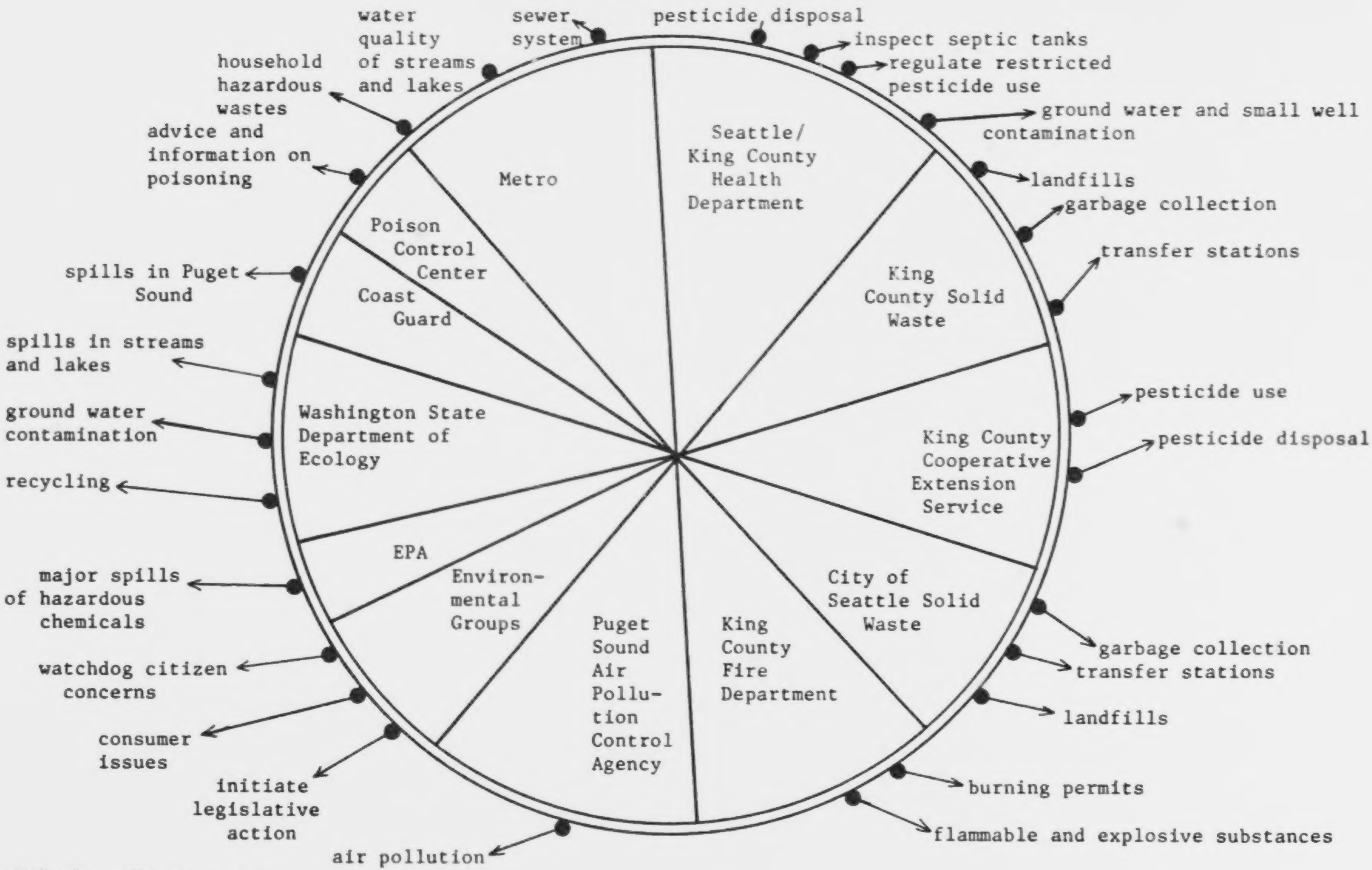
Erickson, Eric. H., Jr., Erickson, Barbara and Flottum, Peter. Honey Bees and Pesticides. The American Bee Journal, Oct.-Dec., 1983. Hamilton, Illinois 62341.

Bromenshenk, J. J., S. R. Carlson, J. C. Simpson, and J. M. Thomas. "Pollution Monitoring of Puget Sound with Honey Bees." Science. February, 1985. pp. 632-634.

CHEMICAL	USE	HEALTH EFFECTS
Arsenic	Used in pesticides, paint, glass, hair dyes and for wood treatment.	Carcinogenic, causes skin diseases, liver and kidney damage, and nervous system disorders.
Lead	Used as solder, to make batteries, in steel production, in bullets, and present in most gasoline.	Causes kidney, blood, and central nervous system diseases. Produces mental defects in children.

Excerpted From "Toxic Time Bombs are Ticking in Washington State" Sunday Seattle Times/P.I. June 26, 1983. Reprinted by permission of The Seattle Times.

WHO IS RESPONSIBLE?


Seattle/ King County Health Department
King County Solid Waste
King County Cooperative Extension Service
City of Seattle Solid Waste
King County Fire Department
Puget Sound Air Pollution Control Agency
Environmental Groups
EPA
Washington State Department of Ecology
Coast Guard
Poison Control Center
Metro
sewer system
pesticide disposal
inspect septic tanks
regulate restricted pesticide use
ground water and small well contamination
landfills
garbage collection
transfer stations
pesticide use
pesticide disposal
garbage collection
transfer stations
landfills
burning permits
flammable and explosive substances
air pollution
initiate legislative action
consumer issues
watchdog citizen concerns
major spills of hazardous chemicals
recycling
ground water contamination
spills in streams and lakes
spills in Puget Sound
advice and information on poisoning
household hazardous wastes
water quality of streams and lakes

Use the Telephone Directory to
locate phone numbers for these
agencies.... (Try the Blue Pages)

SOURCE: See Bibliography. Dyckman, Claire, p. 171

POLLUTED AIR: BEES BEAR BAD NEWS

Lyn Watts, Staff Writer, Journal-American

Beehive tests reveal high level of arsenic, cadmium and fluorine.

Vic Pomel's bees on the east shore of Lake Sammamish may be bearing bad news about the quality of the air on the East Side.

Recent tests of his beehives and others throughout the Puget Sound area show much higher levels of arsenic, cadmium and fluorine than previously anticipated.

A University of Montana professor who coordinated the testing believes Tacoma area industry is to blame, producing contamination-laden smoke which drifts farther than air quality control officers had previously suspected.

For Pomel the tests may explain why his beehives struggle to survive.

"I'm thinking about moving my hives up to Orcas Island," Pomel said. "This is really frightening when you think we're breathing this stuff too."

Arsenic, cadmium and fluorine are three of 103 known chemical elements which are building blocks of life in small doses. In large quantities, they can be lethal. Bees are particularly susceptible to the toxic elements because they pick up contaminated dust when they gather pollen, then ingest it.

Outwardly, Pomel's two beehives appear healthy. Worker bees return gorged with flower nectar, their rear legs packed with bright yellow pollen to feed young bees.

Still, the hives appear weak to Pomel. Young bees aren't hatching fast enough, and honey production is low .

"I knew something was wrong," he said. "But I didn't know if it was a problem with the bees, with the queen or what."

So he agreed to participate in the University of Montana test last fall.

The study found that hives in the Seattle-Tacoma-East Side triangle are contaminated by high levels of the three elements. It found that the death rate of bee eggs in 64 percent of hives tested is far too high, particularly in the East Lake Sammamish area, near Tacoma, in south Seattle and on Puget Sound's Vashon Island. Pomel's bees had abnormally high levels of arsenic, cadmium and fluorine, in its fluoride form in their bodies. And of every 100 eggs laid by queen bees in Pomel's hives only 43 percent are hatching, an extraordinary mortality rate he said.

Author of the study is Dr. J. Bromenshenk, a University of Montana associate professor in botany. He has studied chemical poisoning of bees since 1974. In 1981, the U.S. Environmental Protection Agency gave him funds to study the Puget Sound basin.

Bromenshenk said he was appalled by levels of arsenic and fluoride he found in bees throughout the Puget Sound area. It was well known that Vashon Island, for example, was experiencing pollution from the Tacoma area, but Lake Sammamish was considered too far north to be affected.

By charting results of those chemical tests on maps, Bromenshenk finds that ASARCO Inc.'s Tacoma smelter appears to be the source of high cadmium and arsenic levels. East Tacoma, with its Kaiser Aluminum plant and oil docks, appears a likely source of fluoride concentrations, he said.

"That really startled a lot of people in agencies doing the monitoring down there," he said.

"The pattern of distribution wasn't surprising," said Brent Carson, project administrator for Puget Sound Air Pollution Control Agency. "I guess the distribution was greater than we'd known. He found higher levels of arsenic in bees extended farther to the north than our deposition models have shown."

Carson would not say how his agency will react to Bromenshenk's results, though he said more than one test of bee hives will be necessary to verify the results. "It's a new, nontraditional test," said Carson. "Any new information we can get is of use to us."

He did say his agency does not routinely test for arsenic and other elements outside the immediate area of ASARCO.

"They can't afford to," said Bromenshenk. "Beekeepers managed to cover a geographical area much larger than any of these other agencies."

If funding permits, Bromenshenk hopes to repeat the study yearly to ensure first-year results aren't simply a fluke. He isn't yet certain what his results mean to humans and their health. "We do know that enzyme systems in bees and humans aren't that different," he said. "I want to be able to run enzyme tests on the bees and find out if their systems are being disrupted.

"If that's the case, it would have a directly applicable relationship to man."

His study has prompted the Seattle-King County Health Department to take samples of honey from beekeepers on Vashon, where bee mortality rates from 80 to 100 percent were found at the Island's south end.

"We want to make sure there's nothing wrong with the honey," said Jenet Lee, a health district environmental specialist.

"Some people here are selling their homes, they're so afraid," said Miriam Eash, a north island beekeeper. However, she and Bromenshenk said the health department's study of honey was pointless. "Contaminants are removed by the bees," said Bromenshenk.

"The real point is these things are in the air we breathe and water we drink," added Eash.

Because of his initial results, Bromenshenk has been asked by EPA to study the Tacoma, Maury Island and Vashon Island area. "Our data says those are bad spots. Now they want to know how bad are they," he said.

Meanwhile, local beekeepers have now started the second year of their testing program.

Each beekeeper is asked to perform three tests.

First, they use bulletin-board pins to mark off a postcard-size section of a comb where eggs have been laid. The keeper then counts cells within that section and what's in each cell, such as larval or pupal stages.

Fourteen days later, he returns and determines what has happened in those cells. That information is fed into a computer, which evaluates the hive's survival rate.

In a second test, the keeper uses a vacuum device to capture roughly 300 bees. They are frozen and later evaluated by Bromenshenk's staff.

In a third test, bees returning to hives are forced to walk through a device that brushes pollen from their rear legs. That pollen also is collected and evaluated.

Based on those tests, Bromenshenk determined that arsenic levels far exceeded usual metropolitan levels of less than 1 part per billion. The Kirkland area was low at 1.5 parts per million, Pomel's rate was 4.1 and the rate soared to 7 parts per million near Tacoma. At a level of 3, honey bees eggs hatch at about a 50 percent rate.

For fluoride, 10 parts per million is a usual level. Tests in Pomel's area showed 28 parts per million; Auburn, 117; and near Tacoma, 182. At 100 to 150, bees hatch about half their eggs.

Cadmium levels routinely were between 1 and 3 parts per million throughout the Puget Sound area. Below 1 part per million is expected in an urban environment.

TACOMA POLLUTION SUSPECTED AS KILLER OF PUGET SOUND BEES

By Solveig Torvik - P-I Reporter

Honeybees are dying in the Puget Sound area, and a Montana scientist suspects that high doses of airborne arsenic, lead, cadmium and fluoride from Tacoma's industries may be responsible.

Studies on the bees show that "extremely high" levels of some pollutants are showing up farther away from Tacoma's Commencement Bay industrial sources than previously realized, said Jerry Bromenshenk, an entomologist from the University of Montana. He has been conducting studies of bee poisoning with 65 beekeepers in the area for two years.

Bees, whose role in pollination is crucial to food production, are extremely sensitive to chemicals, which they pick up from vegetation as they forage, said Bromenshenk. So he hit on the idea of using them as a cheap and "early warning system" to detect air pollution.

He said it is not yet possible to make a direct link between the effects on bees and the health effects in humans, but more studies on enzymes common to both species may make this feasible eventually.

The honey produced by the bees is not affected by the chemicals, he said.

'A Red Flag'

Last year 64 percent of the bee colonies in the area had "very poor" brood survival, he said. Some colonies near West Tacoma and Fife lost 97 to 100 percent of the brood. Normally, he said, most bees in the colonies should have survived.

That runs up a red flag that says something is wrong, whether it's pollution or disease or bad management," he said, but he suspects pollution.

The Environmental Protection Agency, which was paying for the study, eliminated funds for the work in recent budget cuts. The study was to have lasted five years.

Bromenshenk said he had hoped the bees could be used to make a chemical "profile" of Puget Sound before the EPA's cleanup of Commencement Bay. After completion of the cleanup, the bee monitoring could be repeated "to see if they have really improved the situation."

Here is what his studies have shown:

*Bees have all but disappeared from Maury Island, which is downwind from the Tacoma industrial complex at Commencement Bay. Bromenshenk said his "hypothesis" is that high levels of arsenic and cadmium in the air killed the bees. Arsenic in bees on Maury Island, the southern tip of adjoining Vashon Island, west and southwest Tacoma, the tideflats of Commencement Bay, and up the coastline to Seattle reaches an "extremely high level" of 7 parts per million, he said. Normally bees show no more than 1 part per million.

However, 80 beekeepers are reasonably successful on nearby central and northern Vashon Island, he said, which raises the question of why the Maury Island beekeepers fail.

*The arsenic from Tacoma, which pollution-control officials say comes mostly from the Tacoma smelter, travels surprisingly far afield. "We've seen arsenic travelling as far as Lake Washington and Lake Sammamish at fairly high levels," Bromenshenk said. "We're getting appreciably high levels of arsenic in south Seattle and Kent and across to Mercer Island." In these areas the levels in bees are three parts per million, "a point at which I become concerned," he said. If those places haven't been examined for human risk, they should be."

*"Extremely high" levels of fluoride have been found in bees near Fife in the Tacoma tideflats and downwind to Sumner and Puyallup, Bromenshenk said. The levels should have been 5 to 10 parts per million; instead they were as high as 182 parts per million. These levels are comparable to what was found in Montana 10 years ago before industry there reduced its fluoride emissions, said Bromenshenk.

Fluoride is taken up by plants directly from the air rather than through the soil, he said, "so its likely to be high in some of the vegetables down there."

Fluoride is emitted by aluminum plants (Kaiser Aluminum is the major source in the tideflats, said the state Department of Ecology), steel mills, oil refineries, chemical and phosphate plants. It can cause crippling diseases in animals and humans and first shows up as spots on the teeth.

*Lead shows up most heavily along freeways, a byproduct of auto travel. The normal amount of lead in bees should be 8 parts per million, he said, but on Whidbey Island, it was 65 parts per million. "Why a hot spot up in Whidbey?" He does not know.

*Zinc levels in bees kept in Seattle were 2 to 3 times higher than in rural areas. There are hot spots of it in Kirkland and Sumner. "It probably doesn't mean much to human health," he said.

The beekeepers were stationed as far south as Puyallup, as far east as Issaquah (with control stations for comparison purposes in Yakima and Cheney) and as far north as Whidbey Island. Others were in such areas as south Seattle, Bothell, and Ballard.

HONEYBEES AS MONITORS OF INDUSTRIAL POLLUTION:
The Work of Dr. Jerry Bromenshenk

By
Todd Peterson
Reprinted from the June, 1984 Edition of
The American Bee Journal

Honeybees, for Dr. Jerry Bromenshenk of the University of Montana, are a powerful biological tool for monitoring the health of the environment. Since 1974, Dr. Bromenshenk has been using honeybees to assess the distribution and intensity of industrial pollution.

"Honeybees provide an early warning - a 'red flag' - of dangerous levels of pollution," he says. "They also enable private citizens to evaluate the quality of their surroundings."

Dr. Bromenshenk first used honeybees as biological monitors when he became involved in an Environmental Protection Agency (EPA) study of the potential effects of two large coal-fired power plants in Colstrip, Montana. The EPA wanted to determine what affect power plant emissions might have on the surrounding grasslands of eastern Montana. Early in the study, Jerry Bromenshenk, whose doctorate is in entomology, learned that there were 6,600 colonies of honeybees in the Colstrip area and that this part of the state produced some of the highest per colony honey yields in the nation. He decided to find out what the bees could tell him about what was coming out of the power plants and where it was going.

He began his research by reading in the chemical and entomological literature. He discovered, often in old, obscure chemical journals, that even in the 1800s and early 1900s considerable work had been done concerning the effects of metal smelters on honeybees. He learned for example of a 1915 case in the Rhineland in which a beekeeper sued a metal smelter for damage to his bees. "It took him 15 years," Jerry Bromenshenk recalls, "but he finally got a favorable settlement."

Dr. Bromenshenk researched other reports of smelter-caused bee kills. He studied the history of legal suits against smelters. And he reviewed the early investigations, some done in the Salt Lake City area, some done at Cornell University and some undertaken in Bulgaria, of the effects of chemical residues on bees.

He also examined more recent information such as the 1974 case of a beekeeper in the Deer Lodge Valley of Montana who had brought suit against the Anaconda Copper Company smelter for the death of 408 colonies of bees. The beekeeper contended that airborne toxic emissions from the smelter 45 miles away had killed his bees. The case was three years in the courts but eventually the beekeeper was awarded a settlement of $3,000.

In subsequent experiments near the copper smelter it was discovered that residues of arsenic, lead and copper caused a long, slow die-off in honeybee colony populations. For example, the overwintering survival rate for Montana averages 95 percent while only 5-10 percent of the colonies near the smelter managed to live until spring.

Using the information from these inquiries, Dr. Bromenshenk designed a research procedure that uses honeybees to measure the intensity and distribution of industrial chemical pollution. In 1980 the EPA approached him to conduct such a study near a lead smelting complex in East Helena, Montana. Of the various pollutants he could look for, Bromenshenk decided to confine his investigation to arsenic. Bees from clean areas, he discovered, contain between 1/10 part per million (ppm) and 1 part per million. Using these as baseline figures and taking into account prevailing winds, he placed bee colonies at varying distances from the lead smelter. The only hitch in the project came when the ten colonies he had located as controls hundreds of miles away in the Clark Fork River Valley were destroyed by a bear. (Jerry Bromenshenk estimates the bear consumed 500 pounds of honey in about a week.) The experiments in East Helena revealed that honeybees were in fact sensitive indicators of smelter emissions.

In 1981 Dr. Bromenshenk began a similar study in the Puget Sound region of western Washington. Tacoma's Commencement Bay at the south end of the Sound has been identified by the EPA as one of the ten worst hazardous waste sites in the U.S. and the ASARCO copper smelter in Tacoma was suspected of being one of the nation's major producers of arsenic pollution. Dr. Bromenshenk asked beekeepers from Tacoma north to Whidbey Island (approximately 70 miles away) to collect pollen samples and returning foragers and to monitor the survival rate of larva. Puget Sound beekeepers responded enthusiastically with 64 ending up doing actual fieldwork.

In this study, Bromenshenk was looking not only for arsenic but also for significant levels of lead, cadmium and fluoride. He learned that when arsenic levels in a hive reach 3 ppm only about 50 percent of the brood survives. He also learned that honeybees in their gathering and storing of pollen tend to magnify fluoride and that a colony with a fluoride level above 100 ppm will likely die.

Fortunately, because of the specialized function of their digestive systems, honeybees filter out chemical contaminants from nectar so that these contaminants do not end up in honey. During Dr. Bromenshenk's Puget Sound study, the King County (Seattle area) Department of Health sampled honey from the study area and found no detectable levels of cadmium or arsenic.

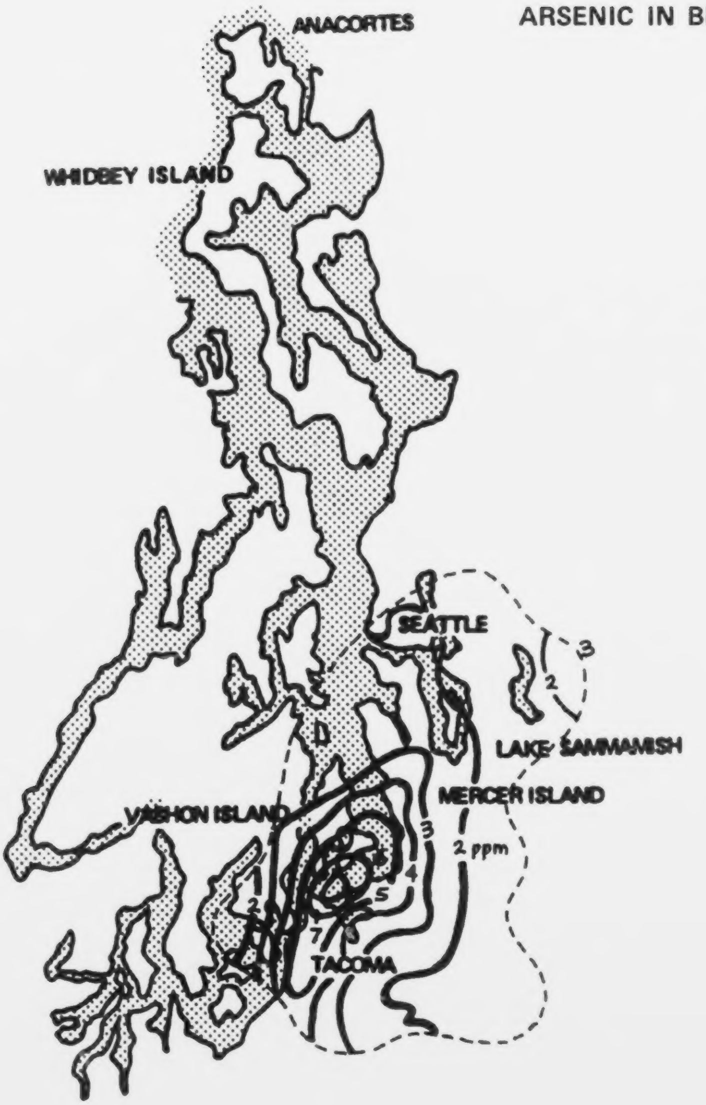
Unfortunately, such was not the case for the bees themselves. Beekeepers in the south Sound area and particularly on Vashon Island downwind from the ASARCO smelter smokestack experienced poor rates of brood survival. Dr. Bromenshenk asked these and other beekeepers in the region to analyze their brood at two-week intervals. He also asked them to collect at hive entrances with a portable vacuum 200-300 incoming bees. These samples were immediately frozen and sent to Bromenshenk who then dried and ground the samples into a fine powder. The powder was "cooked" in a steep pipe at 150 Centrigrade. From here, testing procedures varied depending upon the chemical in question. Dr. Bromenshenk found potentially dangerously high levels of arsenic (up to 12.5 ppm with 0 percent brood survival) and fluoride (up to 182 ppm) in Tacoma area bees. He found very high levels of fluoride in bees from a truck farming area east of the city. (Gardeners in parts of Vashon Island had been advised not to eat their home-grown produce because of high chemical residue levels.) Levels of contamination diminished to the north with virtually no evidence to be found on Whidbey Island.

At the end of the first year of study, funds for the project were cut off by the EPA. In response, citizens, Puget Sound beekeepers prominent among them, bombarded Congress and the EPA with calls and letters requesting the program's continuation. As the result of this public concern Congress wrote into EPA's current budget a supplemental appropriation specifically to fund a two-year renewal of Dr. Bromenshenk's Puget Sound research which is now scheduled to begin again this May. Jerry Bromenshenk said, "We're back doing this research because of interested citizens and citizens' groups."

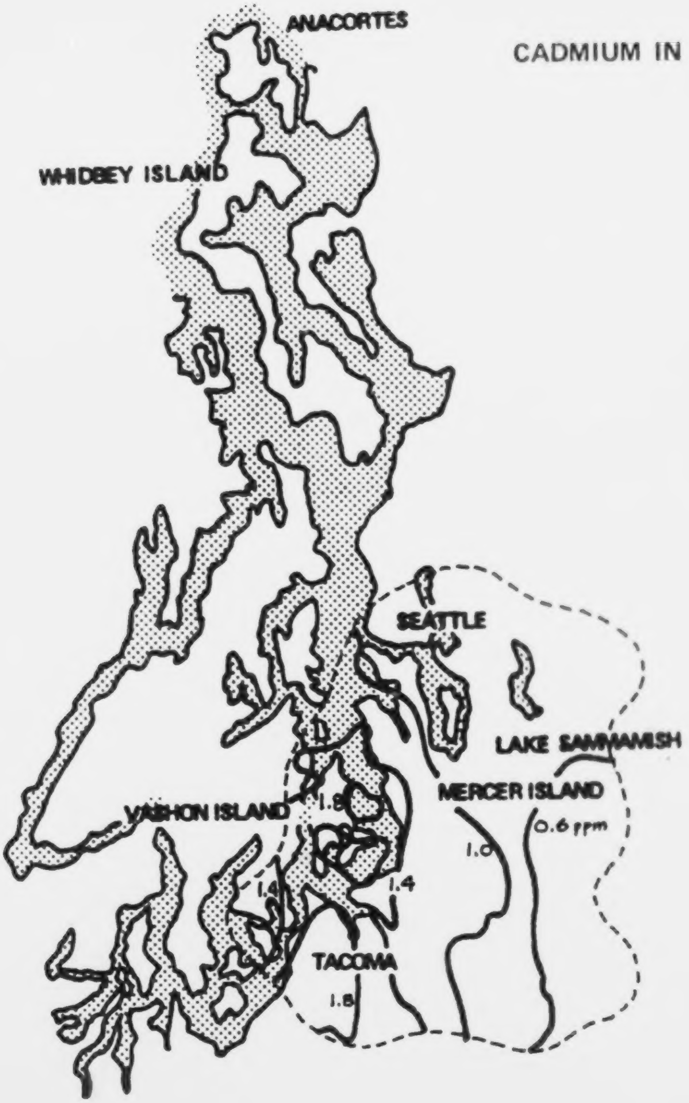
Beekeepers are indispensible to Dr. Bromenshenk's work in many ways. Beekeepers have a right to know about conditions affecting the health of their hives. And when beekeepers know, many more people find out. For example, Puget Sound beekeepers, not Dr. Bromenshenk brought information about honeybees and hazardous waste to the attention of the press.

Dr. Bromenshenk's work is appealing in a unique way. It gives some of those most directly affected - the beekeepers - a chance to get involved in the research. Dr. Bromenshenk has written: "Our results indicate that a volunteer task force of beekeepers can effectively utilize bees for environmental monitoring." Using bees rather than high-volume air filtering devices is relatively inexpensive, and given the large number of hobbyist beekeepers in many areas, many more monitoring stations can be sampled. "A network of hives gives a range and sensitivity that would be difficult and extraordinarily expensive to match with instruments or traditional tests," Dr. Bromenshenk said. The bees themselves are excellent researchers. With their wide foraging range and their close attunement to the environment they collect information essential to maintaining their own health and quite possibly ours.

ARSENIC IN BEES (ppm)


ANACORTES
WHIDBEY ISLAND
SEATTLE
3
2
LAKE SAMMAMISH
MERCER ISLAND
VASHON ISLAND
3
2 ppm
4
5
1
2
7
TACOMA

CADMIUM IN BEES (ppm)


ANACORTES
WHIDBEY ISLAND
SEATTLE
LAKE SAMMAMISH
MERCER ISLAND
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1.8
0.6 ppm
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TACOMA
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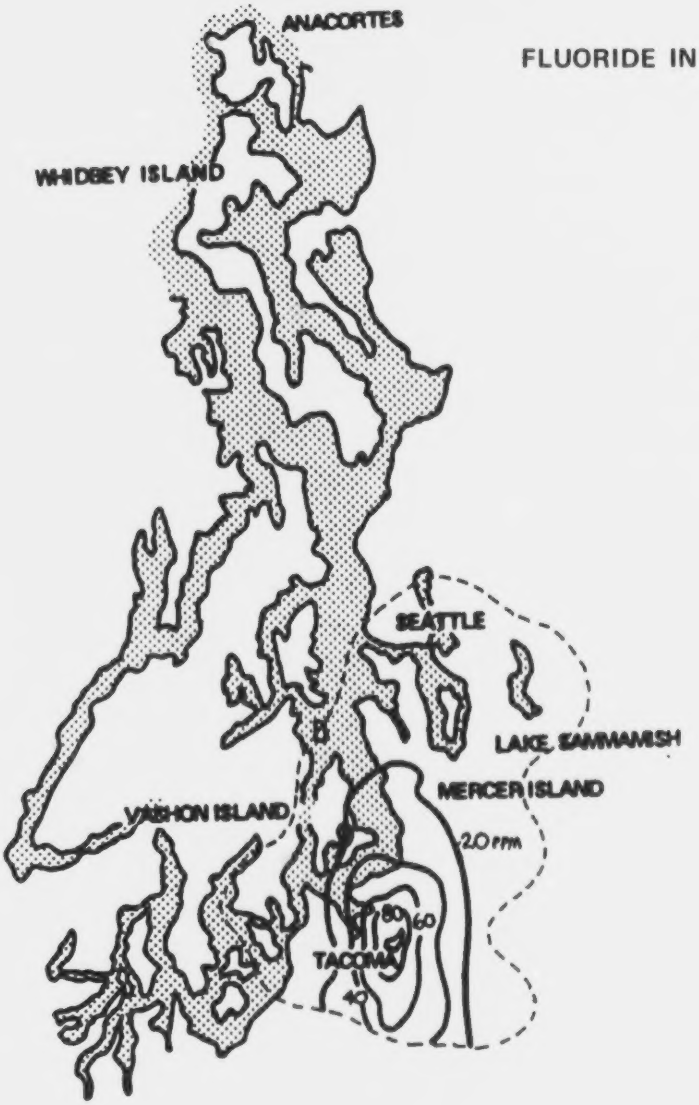
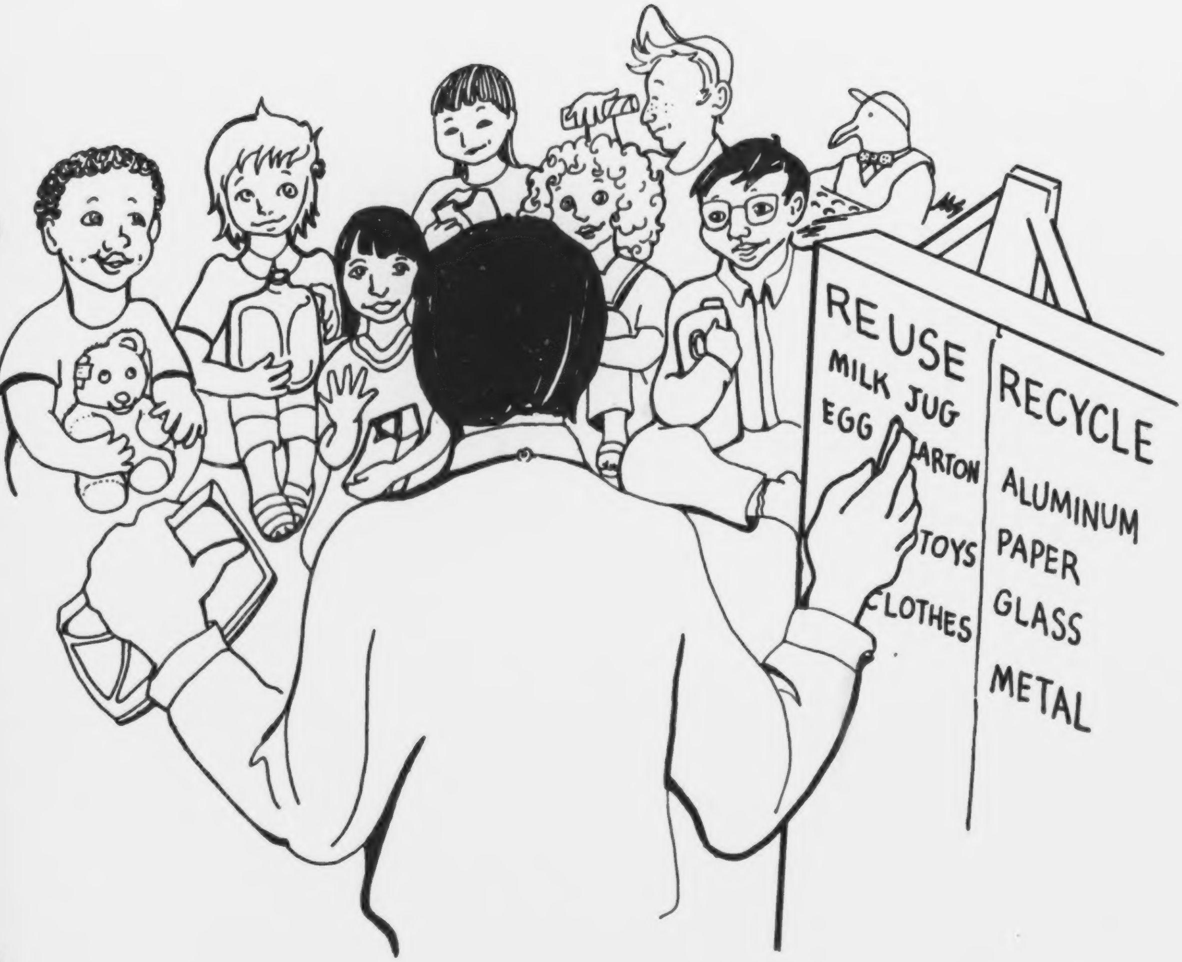
FLUORIDE IN BEES (ppm)


ANACORTES
WHIDBEY ISLAND
SEATTLE
B
LAKE SAMMAMISH
MERCER ISLAND
VASHON ISLAND
20 ppm
80
60
TACOMA
40

REUSE


REUSE
MILK JUG
EGG CARTON
TOYS
CLOTHES
RECYCLE
ALUMINUM
PAPER
GLASS
METAL

TITLE: (RE)SHOW AND (RE)TELL

USE WITH: Be a Garbage Detective, p. 25, No Where is Away or Where Is There Space for Waste?, p. 31, Finders Keepers: Found Object Collage, p. 198.

RATIONALE: One important purpose of solid waste management should be to renew the life of an object by redefining its purpose and using it again.

SUBJECT: Language Arts, Art

GRADES: K, 1

LEARNING OUTCOME: Students will understand and be able to explain that many objects can be reused.

MATERIALS: Objects from home which may often be discarded.

LEARNING PROCEDURE:

1. Display objects in class that are often thrown out after the first use (e.g., cardboard tubes and boxes, plastic containers, TV dinner trays, etc.). Holding up an item, ask students to think of ways that it could be used again. Do this with several items.

2. Ask children to be on the lookout for things at home that could be used again before being discarded (e.g., cans, old toys, old clothes, egg cartons, plastic or paper bags). Ask them to bring that item to school and share with the class the ways their object could be reused.

3. Create a "found art" object out of the assembled materials.

PRE & POST TEST QUESTIONS:

Can you list three things you or someone in your family has thrown away within the last month that you could have used again?

BIBLIOGRAPHY:

Jabs, Carolyn. Re/Uses. New York, N.Y.: Crown Publishers Inc., 1982.

Simons, Robin. Recyclopedia: Games, Science Equipment and Crafts from Recycled Materials. Boston, Mass.: Houghton Mifflin Company, 1976.

Lipschitz, Ceil. An Ecology Craftsbook for the Open Classroom. New York, N.Y.: The Center for Applied Research in Education, Inc., 1975.

TITLE: PICK AN ITEM, ANY ITEM

RATIONALE: What we buy and use has an effect on natural resources.

SUBJECT: Social Studies, Language Arts, Art

GRADES: K-3

LEARNING OUTCOME: Students will be able to list some of the natural resources used to produce a prized possession.

LEARNING PROCEDURE:

1. Define natural resources (e.g. wood, metals, petroleum). List on the board and have students bring in a prized possession. If the item is too large, expensive, or fragile, have students draw its picture. Discuss what natural resources were used in the production of the prized possession.

2. Either at home or in class, list the natural resources used in producing the favorite item.

3. Show and tell time: Have students share their favorites, listing the resources used in producing the items.

   Ask: What other resources could have been used to make your favorite possession? What will be done with it if it is broken? Is there any way it can be reused for another purpose?

4. Find examples of toys made from reused materials (a doll house and furniture, a match box car, etc.).

EXTENDED LEARNING:

1. Discuss the qualities: fragile-short life vs. durable-long life.

   Ask: What are some things we buy and use for only a short time. Examine some of the short-lived items.

   Ask: What about these items could be changed to make them more durable?

2. Make a bulletin board or display that demonstrates the natural resources used in one favorite possession.

3. Make a game consisting of names or pictures of commonly used items and a list or picture page of commonly used natural resources. The teacher supplies the name or picture of the items and the student circles all the natural resources used in its production.

PRE & POST
TEST QUESTIONS:

What are natural resources? List some.

BIBLIOGRAPHY:

Hayes, Denis. "Repairs, Reuse, Recycling - First Steps Toward a Sustainable Society." Worldwatch Paper 23. Washington D.C.: Worldwatch Institute, September, 1978.

White, Peter F. "The Fascinating World of Trash." National Geographic. April, 1983. Vol. 163, No. 4. pp. 424-457.

RESOURCES:

Available from the Washington State Department of Ecology. To order see page 343.

Saving Our Lands. National Geographic Society, 1978. Film strip/cassette tape, 12 min., color.

TITLE: FINDERS, KEEPERS: FOUND OBJECT COLLAGE

USE WITH: (Re)Show and (Re)Tell, p. 195, and Biography of a Favorite Thing, p. 207.

RATIONALE: Reusing items prolongs their lives and reduces the volume of waste going to landfills.

SUBJECT: Art, Science

GRADES: K-6

LEARNING OUTCOME: Students will recognize that: 1) "trash" items may be adapted for functions other than those for which they were primarily designed; 2) "trash" often has interesting shapes, color, texture, and pattern; 3) visual art has its origins in natural and human-made environments.

MATERIALS AND ADVANCED PREPARATION: Teacher: Ask school custodian to save cardboard boxes. Collapse boxes and cut panels for student use (8 x 10 x 24 x 36). Secure a supply of white glue, tempra paints, brushes, newspaper, and magazines. Make or find examples of collages/assemblages. (Braque, Picasso, Cornell, and Nevelson have their assemblages recorded in most art/art history books.) Students: For a designated period of time, collect and save items of trash in a bag or a box.

LEARNING PROCEDURE:

1. Invite students to show examples of particularly interesting colors, textures, or shapes they have found.
2. Show and discuss pictures or examples of assemblages. Emphasize art elements essential for aesthetically pleasing products. (Color, texture, pattern, rhythm, compositional balance)
3. Analyze components and speculate about origins and "life stories" of assemblage parts.
4. Guide students in composing their collages.
5. Frame or mat and post student work.

EXTENDED LEARNING: Social Studies, Art. Examine how other cultures use things that might be considered trash to make amulets, totems, ceremonial items.

PRE & POST
TEST QUESTIONS:

What are attractive properties of some pieces of trash? (Color, texture, shape, size)

What, besides throwing away, could be done with this "trash"?

Where does Art come from?

RESOURCES: Delta Education, Inc. 0815 (Outdoor Biology Instruction Strategies). P.O. Box M., Nashua, New Hampshire 03061.

BIBLIOGRAPHY:

Beal, Graham W. J. Jim Dine: Five Themes. New York, N.Y., Abbeville Press, 1984.

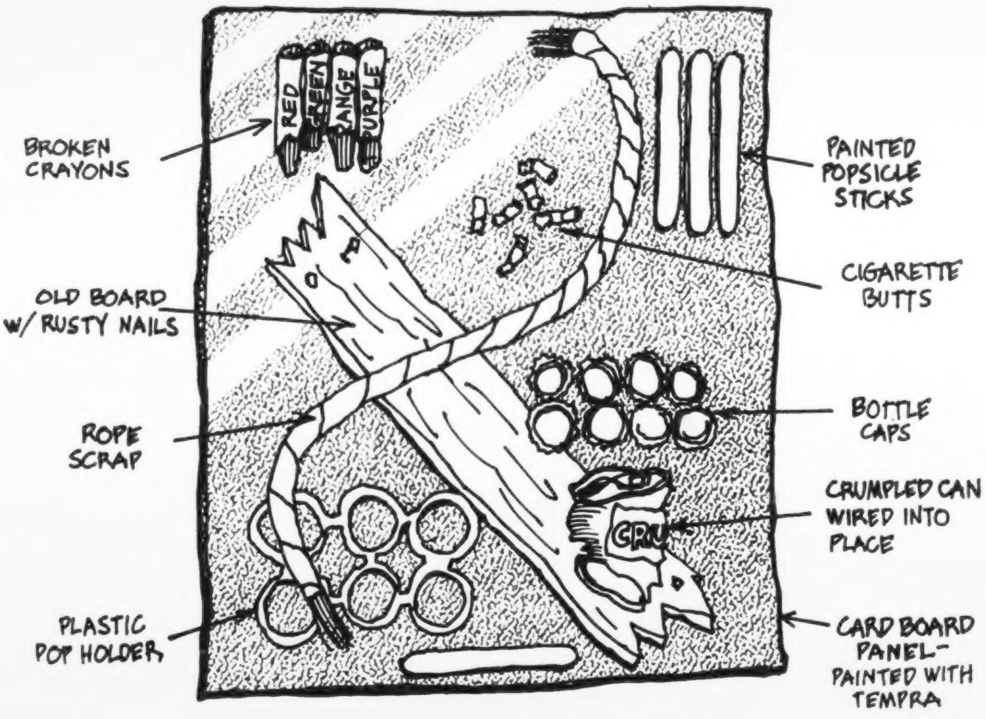
Bober, Natalie S. Breaking With Tradition: The Story of Louise Nevelson. New York, N.Y., Atheneum Pub., 1984.

Gimferper, Pere. Max Ernst. New York, N.Y. Rizzolo Pub., 1984.

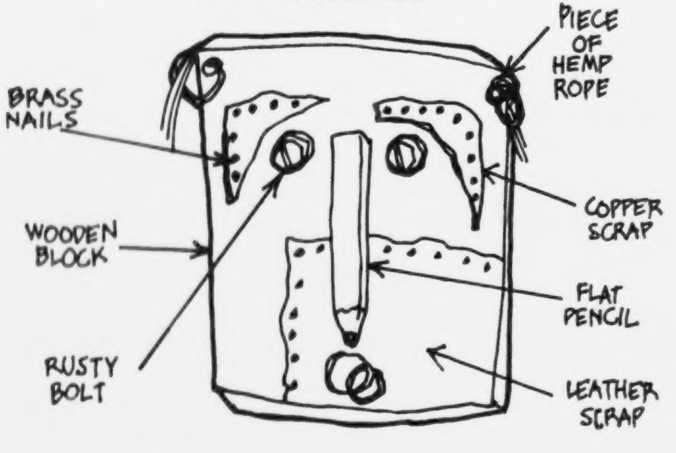
Waldman, Diane. Joseph Cornell. New Yrok, N.Y., G. Braziller, 1977.

White, Peter T. "The Fascinating World of Trash" National Geographic, April, 1983, Vol. 163, No. 4, pp. 424-457.

FOUND OBJECT COLLAGES


RED
GREEN
ANGE
URPLE
BROKEN CRAYONS
PAINTED POPSICLE STICKS
CIGARETTE BUTTS
OLD BOARD W/ RUSTY NAILS
BOTTLE CAPS
ROPE SCRAP
CRUMPLED CAN WIRED INTO PLACE
CRU
PLASTIC POP HOLDER
CARD BOARD PANEL-PAINTED WITH TEMPRA

"Mr. Pencilnose"


PIECE OF HEMP ROPE
BRASS NAILS
COPPER SCRAP
WOODEN BLOCK
FLAT PENCIL
RUSTY BOLT
LEATHER SCRAP

TITLE: WISE USE OF PAPER

USE WITH: Biography of a Favorite Thing, p. 207, and Making Recycled Paper, p. 217.

RATIONALE: We use and throw away enormous amounts of paper. About 30 percent, by weight, of household waste is paper, the largest single component[1]. Annually, each person in the United States uses 580 pounds of paper[2] -- approximately two trees' worth, that's 440 million trees a year used to make paper[3]. Americans consume more paper per person than any other nation in the world.[4] "Paper products use about 35 percent of the world's annual commercial wood harvest, a share that will probably grow to 50 percent by by the year 2000."[5]

Some paper can be reused or recycled, thus saving money and natural resources. Each ton of paper that is recycled replaces and preserves 13-20 500-pound, harvestable trees.[6] Making paper from recycled paper used 30 to 55 percent less energy than making paper directly from trees and reduced the air pollution involved in the manufacturing process by 95 percent.[7]

SUBJECT: Social Studies, Math

GRADES: K-12, and School Staff

LEARNING OUTCOME: Students, teachers, and school staff will understand that they are the first links in the paper recycling process. They will understand that reusing and recycling paper is a way of conserving resources, protecting the environment, and reducing energy use.

MATERIALS: Three boxes
Scale

LEARNING PROCEDURE:

1. Have students collect, for a week, the classroom paper they would normally throw away.
2. Weigh the paper. Divide the collected discarded paper into two boxes:
   a. Paper we can still use
   b. Paper we have used completely
3. When practical, use paper from box "a" for classroom work and assignments.

4. Put this now fully used paper in the third box and weigh. How much paper was reused?

5. Discuss with students where paper comes from. Illustrate on the chalkboard the paper production process (e.g., trees - logging - truck transportation - processing and production - wholesale warehouse - store - you). Emphasize the use of energy at every step of this process.

   Ask: What has happened to the cost of energy in the last five years?

   Discuss the environmental consequences of logging and paper production, the effects on streams, fish, air, and water quality.

6. Discuss what happens to paper when thrown away. Illustrate as in No. 3 (e.g., paper is collected by janitor, thrown into dumpster, piled in garbage truck, taken to landfill). What would be the results if the whole school used two sides of the paper instead of just one? Money saved? Amount of paper used? Pollution reduced? Energy conserved?

7. Referring to the fully used paper -- Ask: Can this paper be recycled into new paper or cardboard? What things are made from recycled paper? (New paper, packaging, including cereal boxes and building materials.) How can you tell if something has been made from recycled paper? (Look for the recycling logo on the package. In the case of cereal boxes, if the cardboard is gray, it was made from recycled paper.) NOTE: 80 percent of recycled paper is used in packaging.[8]

EXTENDED
LEARNING:

1. Working with a partner, make two lists: first, list all the paper products you use at home: and second, list substitute products to use in place of paper products.

PAPER ITEMS	OTHER CHOICES
paper napkins	cloth napkins
paper dishes	washable glasses and dishes
kleenex	handkerchief
paper towels	dishcloths

2. Visit a local paper mill or paper recycling industry.

PRE & POST
TEST QUESTIONS:

What materials do we use in the classroom every day which are made from trees.

How much energy could be saved by making paper from recycled materials rather than directly from trees?

SOURCES:

[1] White, Peter T. "The Fascinating World of Trash." National Geographic. April, 1983. pp. 424-457.

[2] Chandler, William U. Materials Recycling, The Virtue of Necessity. Worldwatch Paper 56, Washington, D.C. The Worldwatch Institute, 1983.

[3] Ohio Office of Litter Control, Columbus, Ohio. 1985.

[4] Op. cit. Chandler, William U.

[5] U.S. Congress, Office of Technology Assessment, Wood Use Washington, D.C.: U.S. Government Printing Office, August 1983), p. 50.

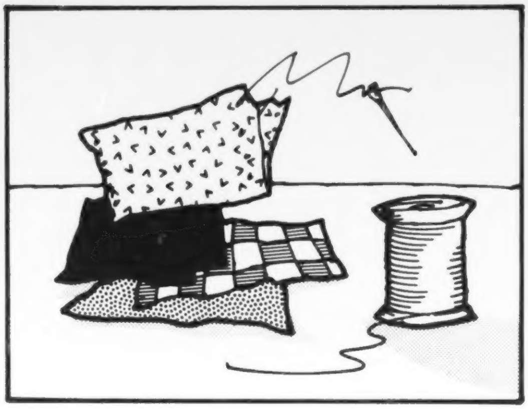
[6] Adapted from information from Scott Paper Company, Consumer Information Center, Scott Plaza, Philadelphia, Pennsylvania 19113

[7] Op. cit. Chandler, William U.

[8] Fibres International, 1533 120th Ave. N.E., P.O. Box 1691, Bellevue, Washington

BIBLIOGRAPHY: Western Regional Environmental Education Council. Project Learning Tree, The American Forest Institute, Inc., 1975.

RESOURCES: Fibres International Pamphlet, "How to Make Paper." Fibres International, 1533 120th Ave. N.E., P.O. Box 1691, Bellevue, Washington, (206) 455-9811.



TITLE: OLD CLOTHES - NEW PATCHWORK

RATIONALE: People can reduce solid waste by making new things from old.

SUBJECTS: Art, Social Studies (History)

GRADES: K-6

LEARNING OUTCOME: Students will learn creative ways to reduce solid waste by reusing some of what they might normally throw away. They will create functional and artistic projects from fabric scraps.

MATERIALS: Patchwork samples, needles, thread or yarn, batting

LEARNING PROCEDURE:

Part I:

1. Bring and have children bring to class colorful worn out clothes and pieces of patchwork.

2. Share pictures of quilts and other patchwork. Ask students where the individual patches may have come from (e.g., red calico could once have been a shirt, denim, a pair of jeans).

   Ask: Why did people in the past make patchwork? In what ways has patchwork become part of our history? (Different patterns represent different time periods or styles.) In what other ways have people creatively reused items that otherwise would have been thrown out?

Part II:

1. Brainstorm ways to reuse fabric scraps. Possible suggestions: to make puppets, quilts, pot holders, braided rugs, books, collages, fabric flowers, purses, pillows, or coupon keepers. (See Extended Learning.)

2. Choose one activity, or let students choose their own. You may wish to create one item as a whole class; i.e., quilt or braided rug.

3. Have able students record steps in the production process. These could be shared with others.

4. Projects could be given as gifts, traded, or sold in the community.

EXTENDED LEARNING:

1. Books: fabric scraps can be used as is for book covers or glued on cardboard. Pages can be sewn in.

2. Coupon Keepers: Fold fabric scrap in half. Students sew up sides with yarn, creating a pouch. (See example.)

3. Investigate different quilt patterns made by different groups in American history.

4. Invite a quilt maker to visit and demonstrate.

5. Let children arrange fabric scraps in patterns at a learning station.

6. Decorate boxes with fabric scrap designs. Use the boxes to collect recyclable materials. Keep a decorated box in the classroom for paper collection.

PRE & POST TEST QUESTIONS:

What other things besides fabric have you thrown away that could have been used again or made into something new?

What things do you or your family reuse at home?

RESOURCES: Film "Creating With Color" 16 mm, CORF, 1967.
Film "Color" 16 mm, Encyclopedia Britannica Educational Corp.

BIBLIOGRAPHY:

Hayes, Denis. "Repairs, Reuse, Recycling - First Steps Toward a Sustainable Society." *Worldwatch Paper 23*. Washington, D.C.: Worldwatch Institute, September, 1978.

Solvit, Marie-Janine. *Pictures in Patchwork*. New York, N.Y.: Sterling Publishing Co., Inc., 1977.

Finley, Ruth E. *Old Patchwork Quilts*. Newton Center, Mass.: Charles L. Branford Co., 1970.

Malone, Maggie. *1001 Patchwork Designs*. New York, N.Y.: Sterling Pub. Co., Inc., 1982.

Breckinridge, M. *Lap Quilting*. New York, N.Y.: Sterling Publishing Co., Inc. 1981.

Editors of Consumer Guide. *Patchwork Quilts*. New York, N.Y.: Beekman House, 1982.

Inoue, B. *Handmade For Kids*. New York, N.Y.: St. Martin's, 1983.

TITLE: BIOGRAPHY OF A FAVORITE THING

USE WITH: Wise Use of Paper, p. 201.

RATIONALE: The natural resources and energy used in the production of an item are partially wasted if the item is not reused.

SUBJECT: Science, Art, Social Studies

GRADES: 3-6

LEARNING OUTCOME: Students will recognize the energy and natural resources used in the making of their favorite possessions, and the waste involved when they are discarded.

LEARNING PROCEDURE:

1. Ask students to pick out a favorite object in their life which is a forest product. Examples: Surfboard, skateboard, wall poster, kite, clogs, book , etc.

2. Invite students to trace the making of their favorite thing back to its origins. Encourage them to find out whether their possessions are entirely forest products. Ask the students to list any resources and energy sources which were used in the manufacture of each item and in the transportation of the materials to make the object. Then

ask the students to make pictures representing all the material and energy input in the entire journey of their objects from the forest to its present location. (One could create a wall mural starting with photosynthesis!)

3. Ask each of the students to count the number of times there was an input of energy in the total production and transportation of their favorite thing.

4. Ask students to include in the pictures what will happen to favorite things when they are no longer wanted. The students can determine the life expectancy of their objects.

5. Ask: What good uses are there for your favorite possession rather than throwing it away? If you throw it away, what will happen to all the energy and resources used in its production?

PRE & POST TEST QUESTIONS:

Make a list of three objects in the classroom made from trees.

What is an "energy input"?

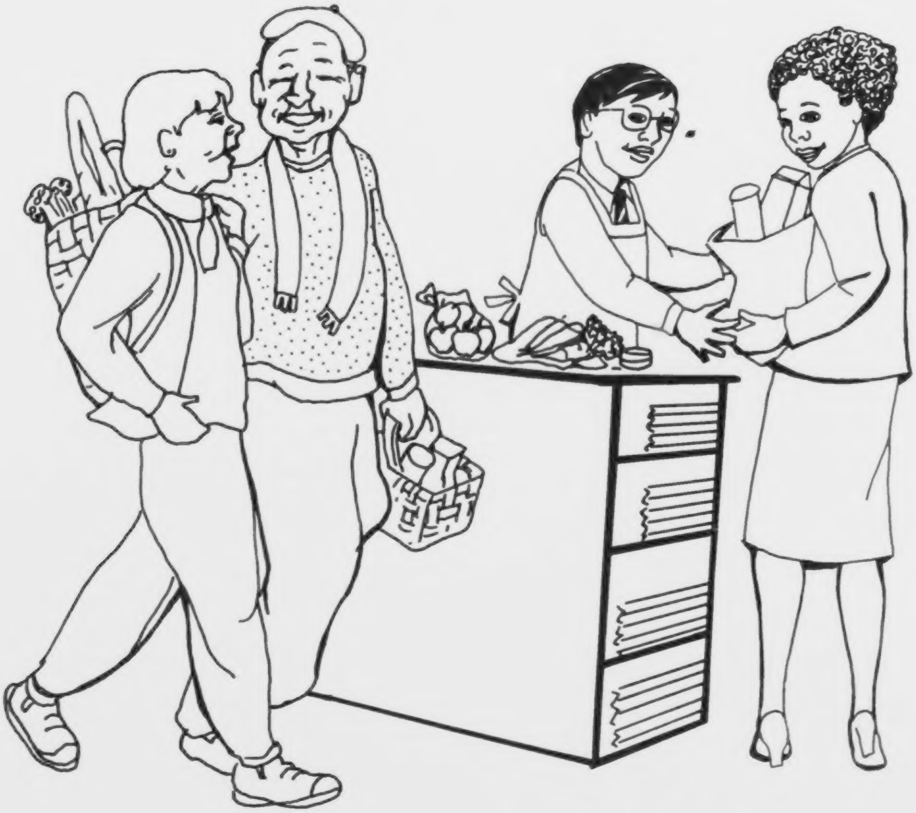
BIBLIOGRAPHY: Western Regional Environmental Education Council. *Project Learning Tree*. The American Forest Institute, Inc., 1975.

Melosi, Martin V. "The Cleaning of America," *Environment*. October, 1983, pp. 6-44.

Jabs, Carolyn, *Re/Uses*. New York, N.Y.: Crown Publishers, Inc., 1982.

RESOURCE: Available from Washington Department of Ecology. To order see page 343.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.



TITLE: I DON'T NEED A BAG

USE WITH: How to Calculate BTU's Per Container, p. 152.

RATIONALE: Food containers and packaging consume energy and are major components of solid waste. "Roughly 40 percent of all American household refuse is packaging material."[1]

SUBJECT: Art, Math, Home Economics

GRADES: 4-9

LEARNING OUTCOME:

1. Students will make containers suitable for carrying groceries home from the store.
2. Students will calculate how many BTU's would be saved in a year by using your own reusable grocery bag.

LEARNING
PROCEDURE:

1. Discuss reasons for carrying groceries home from the store in a reusable bag.

2. Have students figure out how many paper sacks each of their families uses in a year. Calculate approximately how many BTU's they will save in a year by bringing their own shopping bag. NOTE: Packaging-type paper takes 44.9 BTUs/gm to make.

3. Point out to students that some grocery stores give small credits to customers who reuse grocery bags.

   Ask: Does your store give this credit?

4. In Home Economics class, discuss different possibilities for shopping bag design and decorations.

5. Discuss the pros and cons of plastic versus paper grocery bags.

PRE & POST
TEST QUESTIONS:

How many grocery bags does your family use in a week? In a year?

How many ways can you recycle or reuse grocery bags?

List alternatives for paper or plastic grocery bags.

SOURCE: [1]White, Peter T. "The Fascinating World of Trash," National Geographic. April, 1983. Vol. 163, No. 4, pp. 424-457.

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1980.

Melosi, Martin V. "The Cleaning of America," Environment. October, 1983, pp. 6-44.

Simons, Robin. Recyclopedia: Games, Science Equipment and Crafts from Recycled Materials. Boston, Mass.: Houghton Mifflin Company, 1976.

Pringle, Laurence. Recycling Resources. New York, N.Y.: Macmillan Publishing Co., Inc., 1974.

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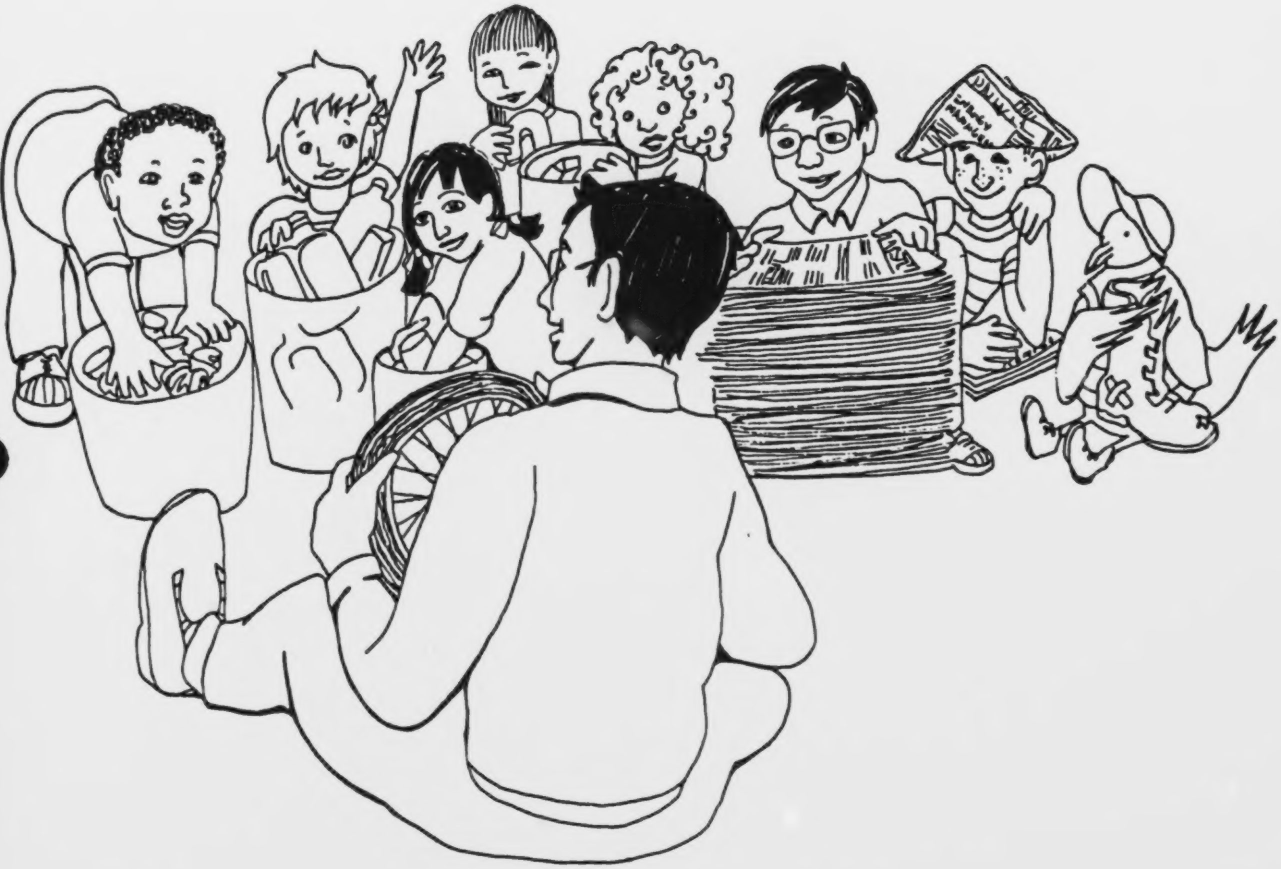
RECYCLE



TITLE: RECYCLE BICYCLE

USE WITH: What's in a Cycle?, p. 222, Pick an Item, Any Item, p. 196, and Biography of a Favorite Thing, p. 207.

RATIONALE: To be motivated to recycle at home, students must understand the basic idea of recycling.

SUBJECTS: Social Studies, Language Arts, Art

GRADES: K-6

LEARNING OUTCOME: Students will understand the roles recycling and individuals play in extending the life of resources.

TEACHER BACKGROUND: As an introduction to this activity for grades 3-5, see the activity What's In a Cycle?, p. 222. Follow up with activities, Research into Recycling, p. 227, and Take-Home Recycling Kit, p. 229.

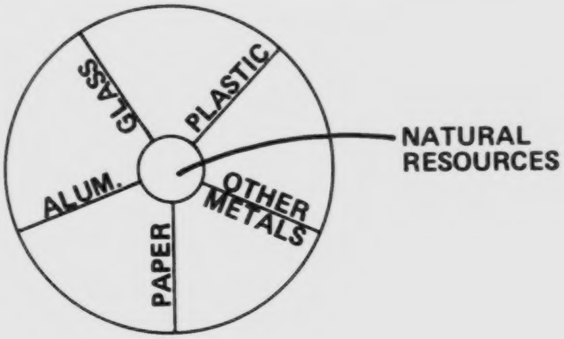
LEARNING PROCEDURE:

1. Discuss cycles including natural cycles such as the oceans-evaporation-rain water cycle.

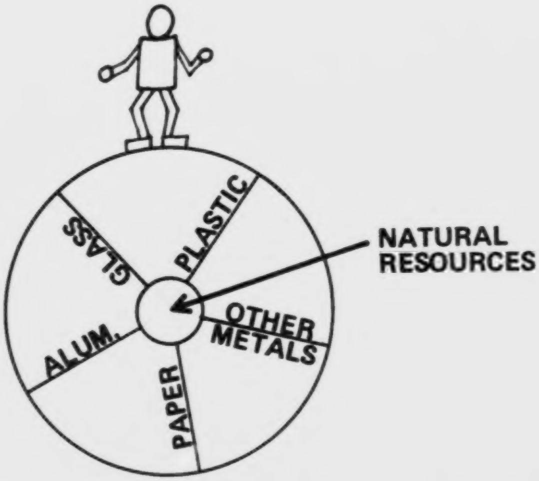
2. Write the word "recycle" on the board and draw a large bicycle wheel with spokes. Write the word "bicycle" next to it and ask the children how the two words are alike. Discuss what cycles are in general, and how this concept applies to garbage.

3. List some of the things students commonly throw away at home. Bring in examples of paper, metal, plastic, etc. Identify categories into which this waste can be grouped (e.g., a pop can is made of aluminum). (NOTE: plastic is a difficult material to recycle and is presently recycled only on a small scale.)

4. Label each spoke of the recycling wheel with one of these category headings. Discuss the original source of all these products and label the hub of the wheel natural resources.



4. Ask: "What do you do with items from these categories once you have used them at home?" Draw a person on the rim to show that the individual has a choice to either keep the material in the cycle of use, or to discard the waste in a landfill where the resources and energy that it is made of are lost forever.



PRE & POST
TEST QUESTIONS:

What are natural resources? Name three.

What is a cycle?

Why should we recycle?

Name three materials you could recycle.

BIBLIOGRAPHY: United States Environmental Protection Agency. Let's Recycle!: Lesson Plans for Grades K-6 and 7-12. Washington, D.C.: Office of Waste and Waste Management, 1980.

Recycling Hotline. Guide to Household Recycling. Olympia, Wa.: Washington State Department of Ecology, 1982.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Go. Dowling-Shepard Productions, 1979, 16 mm., 10 min., color.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE:	SOME CANS ARE MORE "ATTRACTIVE" THAN OTHERS
RATIONALE:	There are three general categories of metal cans: aluminum, tinned, and bimetal. Of these three, bimetal is the most difficult to recycle and should therefore be avoided.
SUBJECT:	Science, Social Studies
GRADES:	1-3
LEARNING OUTCOME:	Students will learn how to tell the differences between aluminum, tinned and bimetal cans by using magnetism and by observing differences in appearance.
MATERIALS:	Small magnets (Provided by Department of Ecology - order by referring to p. 343). Samples of aluminum, tinned and bimetal cans.

LEARNING PROCEDURE:

1. If you have not already done so, discuss how waste is reduced by recycling. Review what recycling means (you may want to refer to the activities Recycle Bicycle, p. 212, or What's in a Cycle?, p. 222).

2. Tell students that cans are recyclable, but that some are much easier to recycle than others. Hold up samples of the three major types of cans: aluminum (i.e., pop cans), tinned -- these are really 99 percent steel with a thin coating of tin (i.e., soup cans) and bimetal (i.e., often tuna fish cans, small apple juice, and tennis ball cans are bimetal). Explain that bimetal cans are cans that have an aluminum top and a steel body. "Bimetal" does not refer to a can that has two metals combined to form an alloy.

3. Note that, at first glance, these cans are very similar in appearance, but that it is important to tell the differences because the bimetals are not easily recyclable, and we should therefore avoid buying these. It is also important to be able to identify the type of can because different types need to be separated before being brought to the recycler.

4. Explain and demonstrate to students the following ways to tell the differences between metals:

   a. Magnetism

      (1) Hold up a magnet. Ask for a show of hands of those who have experimented with magnets. Did they notice the things that magnets will attract? Explain that magnets are pieces of

iron or steel that can attract iron or steel. (This property may be naturally present or artificially induced.) Experiment with some object to show some of the metals the magnet will attract and others that are not attracted.

(2) Demonstrate that magnets attract tinned and bimetal cans, but not aluminum cans.

b. Appearance

Pass out can samples. Ask class to point out the differences they see between the cans (i.e., weight, seams, color, shininess). Tell them that bimetal cans look almost identical to aluminum cans. The following is a chart which lists the differences. It is best to compare the cans at the same time to see some of these differences.

Aluminum	Bimetal	Tinned
*1. Is not attracted by a magnet	*1. Is attracted by a magnet	*1. Is attracted by a magnet
*2. Almost all of these cans say "All Aluminum Can" on the side	*2. Bottom has a rim	2. Always has a seam
*3. No seam	3. If you look closely, the bottom is not finely brushed. It is also usually spray painted	3. Heavier weight than aluminum
*4. If the bottom of the can is round and more shiny then it is aluminum	4. (May or may not have a seam)	4. (Usually has rings or ribbing on the can and normally has a paper label.)
5. Shiny, silver, smooth		
6. Light weight		
7. Aluminum cans, if you look closely are finely brushed on the bottom		
8. Printing is usually directly on the can as opposed to on a paper label.		

(*"sure thing" identification)

5. Set up a station in the room so that one person or one group of students at a time can practice separating cans using magnets and observing the above differences. (You may want to provide a magnifying glass.)

6. Demonstrate how to prepare cans for your recycler (Contact the WDOE toll-free Recycling Hotline, 1-800-RECYCLE, for the name and number of the recycler nearest you. Find out what kinds of cans are accepted and how to prepare them. For example, many recyclers do not accept bimetal cans. Find out how much is paid for different types of cans.)

   Ask: Do you know how to tell the differences between cans? What kind of cans should be avoided when possible? What would save more energy and resources than recycling? (Answer: not buying in the first place. Is that possible? Sometimes? All the time?)

EXTENDED LEARNING:

1. Start a classroom recycling center for metal. Make sure all cans are already cleaned and flattened when brought to school.
2. Have students draw a cartoon or write a description of how to ready cans for recycling.
3. Study maps of where aluminum is mined.
4. Investigate how steel is made.
5. Discuss percentage of energy saved by recycling iron and steel (60-70 percent) and aluminum (90-95 percent).

PRE & POST TEST QUESTIONS:

Name three ways to tell if a can is aluminum or bimetal.

Name three ways to tell the difference between tinned and bimetal cans.

ACKNOWLEDGMENT:

Special thanks to Armen Stepanian, Fremont Recyclng, 3505 Evanstone N., Seattle, Wa. 98103, for information on bimetal cans.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home. Olympia, Wa.: 1983.

Magnets used to test and separate aluminum, tinned and bimetal cans for recycling.

TITLE: MAKING RECYCLED PAPER

USE WITH: Wise Use of Paper, p. 201, Can We Do Without the Can?, p. 43.

RATIONALE: Recycling conserves natural resources and reduces solid waste.

SUBJECT: Science, Social Studies, Art

GRADES: 2-5

TEACHER BACKGROUND: Between 1978 and 1980, every American used 580 pounds of paper per year. In comparison, the people of Australia used 295 pounds per person per year and the people of Nigeria, 7 pounds. During the same period, the United States recycled 26 percent of the paper it consumed.[1]

"Paper constitutes fully 50 percent of the nation's municipal waste by volume."[2]

LEARNING OUTCOME: Students will recycle used paper into new, usable paper.

MATERIALS: Used paper of various kinds, wide-mouthed beakers, large coffee cans, straining cloth, household bleach, starch, water, scale, large framed screens, rolling pin or tool for rolling paper.

LEARNING PROCEDURE:

1. Make recycled paper by using the following procedure:

    a. Tear sheets of used paper into small strips.

    b. Weigh the paper strips and place in wide-mouth beaker of boiling water.

    c. Boil and stir the paper strips into a mass of fibers. Add water as necessary. If heavy, uncoated paper such as loose-leaf or duplicator stock is being recycled, add 25 percent household bleach solution to the solution to promote paper breakdown.

    d. Two 40-minute class periods should be sufficient time to work the paper into a mass of fibers. Two tablespoons of starch can be added to the pulp to strengthen the recycled paper.

    e. Stretch straining material over basins and plenty of newspaper to catch the water, water/bleach solution. Large, framed fine meshed screens work best.

    f. Pour the pulp solutions onto the screens.

g. If plastic sheeting is available, cover the wet pulp with plastic. In any case, roll the pulp to a uniform thickness using rolling pins, pipes, test tubes, or ring stand bars. The wet pulp may also be removed from the straining screen, placed between two sheets of plastic and then rolled. (NOTE: At this stage, dried flowers can be pressed in as embellishments.)

h. Separate the wet recycled paper from the strainer, screen or plastic and allow to dry for a day or two on a window screen. Another method is to place the wet recycled paper between two sheets of blotter paper and iron with a clothes iron.

i. When the recycled paper is dry, weigh it to reach conclusions about yield from the original used paper. NOTE: Another step-by-step procedure for classroom recycling of paper is outlined in the pamphlet, "Making Your Own Paper at Home by Recycling," available from Fibres International, P.O. Box 1691, 1533 - 120th Ave. N.E., Bellevue, Wa., (206) 455-9811.

Ask: What are the benefits of recycling paper? What are the drawbacks? Why would it be good to use less paper even if it is recyclable? How could we use less? How could we generate less waste paper in the classroom?

2. Contact your local recycling center or the Washington Department of Ecology's Recycling Hotline, 1-800-RECYCLE, to learn what types of paper are commercially recycled, how to separate and bundle paper for recycling, and the location of the paper recycler nearest you.

3. Weigh all the waste paper the class generates in a week. The next week, separate all the paper suitable for recycling. Then weigh again the amount that gets thrown away and determine how much paper the class can save for recycling. Have a contest with another room to see who can recycle the most paper.

EXTENDED LEARNING: Visit a pulp or paper mill. Start a school-wide recycling program (see guidelines in the school recycling program options section of this guide.) Use recycled paper for stationary, cards, drawing paper. Brainstorm new uses for recycled paper.

PRE & POST TEST QUESTIONS:

What natural resources are conserved when paper is recycled?

What kinds of paper can be recycled?

How should you separate paper to take to a recycling center?

SOURCES:

[1] Waste paper data, 1978-80 (Rome: FAO of the United Nations, April 1981) as cited in Worldwatch Paper 56. *Materials Recycling: The Virtue of Necessity*. p. 13.

[2] Moore, Dennis. "Recycling: Where Are We Now?" *New Shelter*. Feb. 1982. Emmaus, PA, Rodale Press, 1982. p. 59.

BIBLIOGRAPHY:

Stein, Roy. "Recycling Paper: An Ecology Experiment," *Science Activities*, June 1973, Vol. 9, No. 5, p. 29.

Western Regional Environmental Education Council. *Project Learning Tree*. The American Forest Institute, Inc. 1975.

Melcher, Joan. *Connections: A Curriculum in Appropriate Technology for the Fifth and Sixth Grades*. Butte, Mt.: National Center for Appropriate Technology, 1980.

RESOURCES:

Experimenting: Make Your Own Paper at Home by Recycling. Fibres International, P.O. Box 1691, 1533 - 120th Ave. N.E., Bellevue, Wa., (206) 455-9811.

TITLE: PAPER FROM THE URBAN FOREST

USE WITH: Wise Use of Paper, p. 201, and Can We Do Without The Can?, p. 43.

RATIONALE: Fiber from the "urban forest" -- recyclable paper -- can be a raw material for making paper just as is fiber directly from trees of the natural forest. As paper from trees becomes more difficult and environmentally costly to obtain, paper from the "urban forest" will become more valuable.

SUBJECTS: Science, Social Studies

GRADES: 2-5

LEARNING OUTCOME: Students will understand that paper can be made both from trees and from recycled paper. Students will understand some of the energy and environmental costs of paper production.

LEARNING PROCEDURE:

1. Read the information about resource and energy conservation made possible by paper recycling in the activity "Wise Use of Paper."
2. About how long does it take a tree to grow a size big enough to be harvested? (In Washington State, it used to take 50-60 years, but younger and smaller trees are now being processed).
3. In what ways is energy used in the making of paper? (Energy to run logging equipment, factory machinery, etc.) See illustration next page.
4. How does cutting trees for paper affect the environment? What are the effects on wildlife, fish, soil, and air?
5. As forests near cities and paper mills get cut down, where else can we look for a supply of raw material with which to make paper?
6. How can we contribute to the wise use of the resources of the "urban forest?"

PRE & POST TEST QUESTIONS:

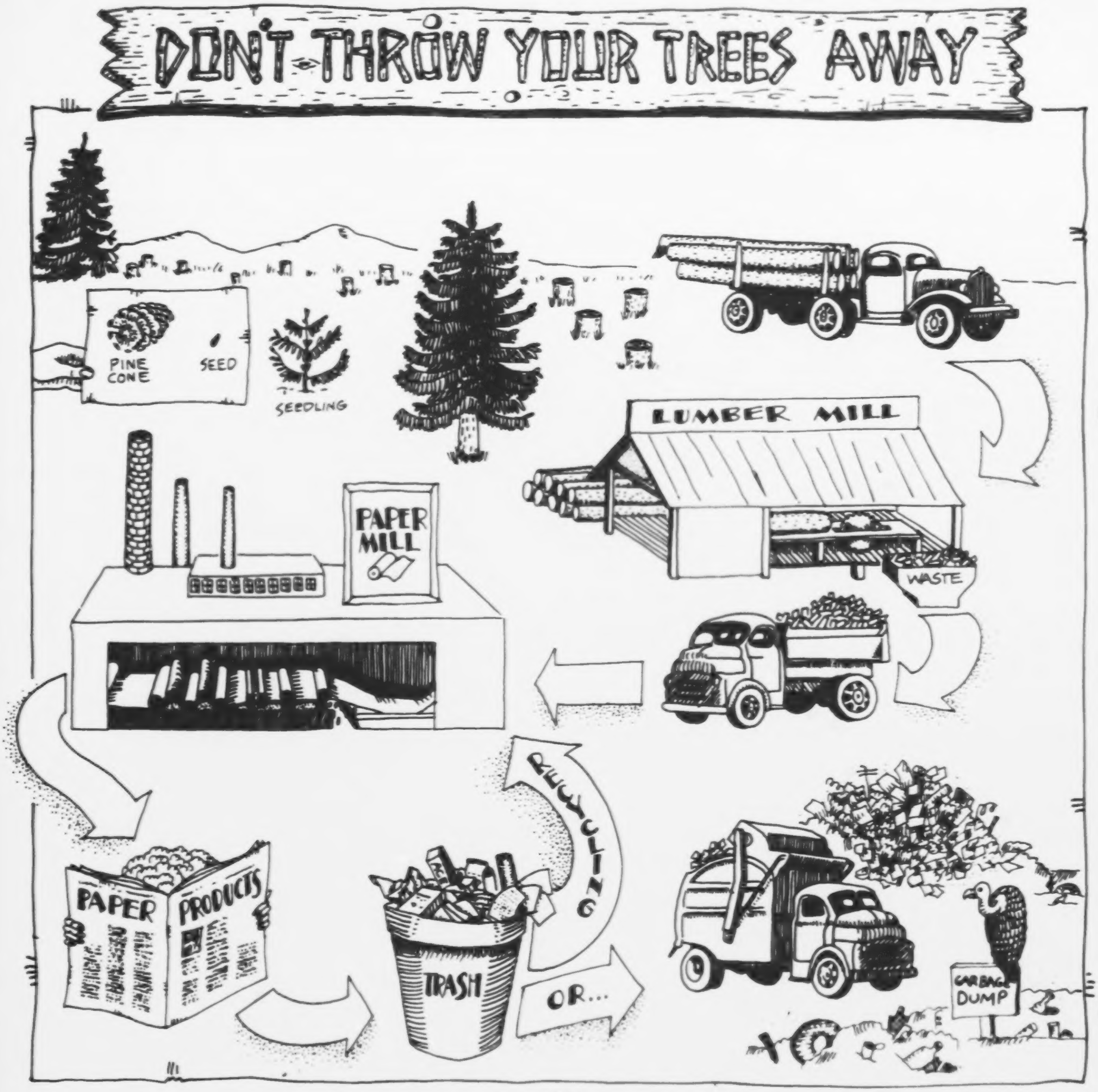
What is the "urban forest"?

What are some of the raw materials for paper making found in the "urban forest"?

What effect does the cutting of forests have on soil, streams, fish, and air?

BIBLIOGRAPHY:

Brown, Bruce. "Mountain in the Clouds: A Search for the Wild Salmon." New York, N.Y.: Simon and Schuster, 1983.


DON'T THROW YOUR TREES AWAY
PINE CONE
SEED
SEEDLING
LUMBER MILL
WASTE
PAPER MILL
PAPER PRODUCTS
TRASH
RECYCLING
OR...
GARBAGE DUMP

TITLE: WHAT'S IN A CYCLE?

RATIONALE: In order to understand the importance of recycling, students must first understand the meaning of "cycle" and how cycles are important.

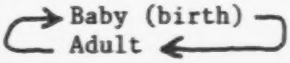
SUBJECT: Social Studies, Science

GRADES: 2-5

LEARNING OUTCOME: Students will be able to identify, compare, and evaluate cycles.

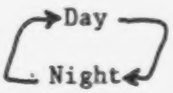
LEARNING PROCEDURE:

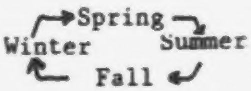
1. Explain to students that cycles are an important aspect of life on earth. A cycle may go through many phases, yet it always arrives back at the point of origin. Thus, cycles ensure that life can go through many changes, and yet maintain stability. Write on the board and examine the following cycle of life:

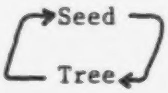
   

   We could also include in this cycle the many stages from birth to death to new birth. However, in simplest terms, this cycle shows how life is able to change, through new birth, and yet remain stable. The new life is patterned after the old.

2. Explain to students that there are endless cycles around us. Ask: Can you think of any?

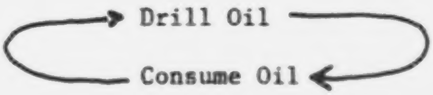
   

3. Cycles are also important to our everyday lives. Can you draw a cycle of your typical Tuesday at school? A cycle of your typical week? What would happen if every day or every week were completely different, that is without repeating pattern? (You couldn't build on the past, wouldn't be able to accomplish as much, wouldn't be able to cope with so much change.)

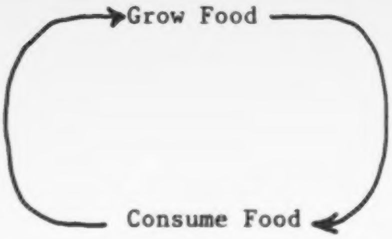
4. Once any step in a cycle is disrupted, the cycle ceases or is altered. What is wrong with this process?

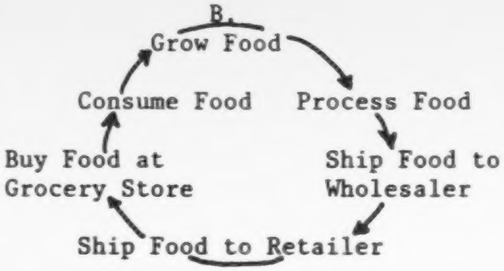
   (This process cannot go on forever - oil is not a renewable resource.)

5. Cycles ensure survival. Compare these two cycles:

A.



B.



Which of these cycles of food consumption represents our lifestyle?(B) Which cycle can be more easily disrupted?(B) Why? (Because it involves more steps and could be interrupted by unforeseen outside forces disrupting the continuum of the cycle) Which cycle is more dependent on nonrenewable natural resources?(B)

Ask: What is a nonrenewable resource? Can anyone give an example of a nonrenewable resource? (A natural resource is nonrenewable because of the great length of time needed for its formation. Petroleum is a good example of a nonrenewable natural resource.) What are some other nonrenewable natural resources you can think of? List on the board.

A.
Mine Aluminum

Consume
Make Aluminum Cans

B.
Mine Aluminum

Return Cans to Manufacturer
Make Aluminum Cans

Consume

Which is a cycle? What part of "B" is a true cycle while "A" is not? Draw in the arrows.

What is the last stage in "A"? (lost in the landfill.)

What is the true cycle in "B" called? (recycling) What is the advantage in recycling? (saves nonrenewable resources, conserves energy)

6. Using another nonrenewable natural resource from the list on the board, draw another cycle that is made possible by recycling.

PRE & POST
TEST QUESTIONS:

What is meant by the term "nonrenewable natural resource?"

List three nonrenewable natural resources.

How does recycling conserve natural resources?

List two nonrenewable natural resources you conserve by recycling.

BIBLIOGRAPHY: United States Environmental Protection Agency. *Let's Recycle!: Lesson Plans for Grades K-6 and 7-12*. Washington, D.C.: Office of Waste and Waste Management, 1980.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Go. Dowling-Shepard Productions, 1979. 16 mm., 10 min., color.

TITLE: RECYCLING IS OUR BUSINESS, IS IT YOURS?

USE WITH: Would You Do It If I Taught You? If I Paid You?, p. 72, and The Goodness of Your Heart vs. The Bottom Line, p. 244.

RATIONALE: A local recycling center can be a good example of a business because its operation is easily understood.

SUBJECT: Social Studies

GRADES: 3-5

LEARNING OUTCOME: Students will define "business" by looking at a recycling center.

MATERIALS: Telephone book, dictionary, city map

LEARNING PROCEDURE: Students will understand that ". . . if somewhere along the line recycling doesn't pay enough, it won't be done, at least not for long."[1]

1. Arrange to have a recycler come to the class. Contact the Department of Ecology's Toll Free Recycling Hotline (1-800-RECYCLE) for the name and number of a recycler in your area.

2. Before the visit, ask each student to look up "Recycling Center" in the yellow pages of the phone book. Do we have a recycling center in our community?

3. Ask students to look up the word "business" in the dictionary.

4. What makes recycling a business? (It provides a needed service, a person can make a living from it, commodities are exchanged, etc.)

5. Ask students what a recycler needs in order to do his job. Are these needs the same as for any other business?

   Examples

   building
   money
   customers
   employees
   goods (cans, bottles, newspapers)
   transportation
   public understanding of the business

6. Now that the class understands recycling is a business, have students prepare questions for the recycler.

7. After the recycler's visit, obtain city maps and ask students to locate the recycling center. Have students take turns tracing the route from their homes to the recycling center.

8. Either as a class or individually, visit the recycler's business with some recyclables from home.

PRE & POST
TEST QUESTIONS:

What makes recycling a business?

How can a recycler help you and your family? school?

Name three materials you use every day you could take to a recycling business.

How does a recycling business help to save energy and resources?

SOURCE: [1]White, Peter T. "The Fascinating World of Trash," National Geographic. April 1983. Vol. 1653. No. 4. p. 450.

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1979.

Pringle, Laurence. Recycling Resources. New York, N.Y.: Macmillan Publishing Co., Inc., 1974.

Hohn, James. Recycling: Reusing Our World's Solid Waste. New York, N.Y.: Franklin Watts, Inc., 1973.

Recycling Hotline. Every Community Should Have a Recycling Center. Olympia, Wa.: Washington State Department of Ecology, 1977.

RESOURCE: Available from Washington Department of Ecology. To order, see page 343.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min. color.

TITLE: RESEARCH INTO RECYCLING: A QUESTIONNAIRE ABOUT RECYCLING FOR FAMILY AND COMMUNITY

USE WITH: Take-Home Recycling Kit, p. 229, and The Road to Recovery, p. 297.

RATIONALE: An understanding of their potential audience will help students prepare a take home recycling kit.

SUBJECT: Social Studies, Language Arts

GRADES: 3-6

LEARNING OUTCOME: Students will gain information necessary to prepare home recycling kits. Students will gain understanding of their communities' recycling attitudes and habits.

LEARNING PROCEDURE:

1. Introduce or review the steps outlined in this guide for preparing the take-home recycling kit. See p. 229.

   Ask: What information from families and the community would be useful in preparing the take-home recycling kit?

   Questions might include:

   a. Which of the following do you recycle? (circle)

      compostables
      paper (list kinds)
      newspaper
      aluminum cans

      steel (tinned) cans
      glass (all, some)
      plastic
      none of the above

   b. If you do not recycle, would you be willing to do so if you had more information about how to do it?

   c. Do you think it is important for school children to learn about recycling and resource management?

   d. If you do recycle, where do you take your recyclables?

   e. Would you be willing to accompany the class on a recycling field trip?

   f. Would you be willing to help the class set up a recycling project at the school?

2. Invite a recycler to class to explain recycling and help prepare the questionnaire.

3. Send home questionnaires to be completed by families and neighbors.

4. Use responses in preparing the take-home recycling kit and in planning further class recycling activities.

EXTENDED LEARNING: For more extensive recycling activities, see the School Recycling Program Options, p. 317.

PRE & POST TEST QUESTIONS:

What can you do to teach your family how to recycle?

List the recycling centers nearest your home. (Call 1-800-RECYCLE for information.)

BIBLIOGRAPHY: Steppingstones. Recycle: For Grades 4-6. 10 Willow Ave., Somerville, Ma: 02144, 19__.

United States Environmental Protection Agency. Let's Recycle!: Lesson Plans for Grades K-6 and 7-12. Washington D.C.: Office of Waste and Waste Management, 1980.

Ohio Department of Natural Resources. Looking Good in Ohio's Schools. Columbus, Ohio: Office of Litter Control, 1982.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling. Olympia, Wa., 1982.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE: TAKE-HOME RECYCLING KIT

USE WITH: Research into Recycling, p. 227.

RATIONALE: Each resident of Washington State discards the equivalent of 4.6 pounds of waste daily.[1] This figure includes industrial and agricultural wastes. More than 50 percent of what we waste is reusable or recyclable. The loss of natural resources and energy and waste disposal costs, both environmental and economic, make home source separation an important alternative.

SUBJECT: Social Studies, Language Arts, Art, Consumer Ed.

GRADES: 3-6

LEARNING OUTCOME: Students will be able to:

1. Help solve home and community waste problems by constructing a take-home recycling kit.
2. Explain to their families and community groups the whys, whats, and hows of home source separation.

TEACHER BACKGROUND: This activity is best used as a follow-up to Research into Recycling, p. 227, Recycle Bicycle, p. 212, What's in a Cycle?, p. 222, and other activities listed in the Recycle section.

MATERIALS: Have students bring from home a cardboard box or five 8½" x 11" pieces of cardboard, magazines, a piece of used foil and used ribbon or twine. (Emphasize to students that they are recycling by reusing these materials.)

TEACHER MATERIALS:

Marking pens, glue, scissors, hole punch, variety of colored construction papers.

LEARNING PROCEDURES:

1. Assemble the "Take-Home Recycling Kit":
   a. Have students cut cardboard into five 8½" x 11" pieces.
   b. Glue differently colored sheets of construction paper to one side of each cardboard piece.
   c. Have students label the top of each piece of construction paper using the following headings: Glass, Paper, Aluminum, Tin.

2. Using the following "How to Recycle Sheet," do one of the following:

    a. For younger students -- copy the sheet for each student. Have them cut the copied sheets on the dotted lines and paste the pertinent information on the bottom of the appropriate card.

    b. For older students -- give them the copies sheet and have them transfer the information in a creative manner.

3. Using the magazines, cut out pictures of the different categories of waste. Paste these pictures below the label and above the directions on the corresponding cardboard sheets to form collages. In making the aluminum card, use aluminum foil brought from home.

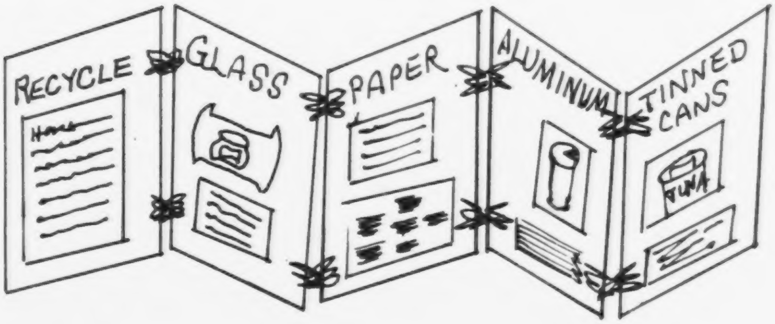
4. Ask students to label the remaining sheet "Recycle."

5. Copy the "How to Set Up Your Home Recycling Center" sheet for each student.

6. Read and discuss with students how they might set up centers in their homes. Paste this copy on the "Recycle" sheet.

7. Have students draw a floor plan of their home and property, marking places where they could set up home centers. Paste this plan on the back side of the recycle sheet.

8. Have students punch two holes on the right hand side of "recycle" sheet, two holes on both sides of the "paper," "glass" and "aluminum" sheets and two holes on the left side of "tinned cans" sheet. Connect the sheets with ribbon or twine.



2. Presenting the Kit:

   a. In preparation for teaching their families, have students in class practice in groups. Each group discusses various approaches and selects one group member to present his or her kit to the class. Following presentations, discuss which approach might be most successful. Students practice their presentations in pairs until they understand and can effectively communicate the information to each other.

   b. Have students present their kits to their families and report back in class on the reactions to their presentations.

3. List the students successful in establishing home recycling centers.

4. At the end of one month, reward students who have set up and helped continue to maintain home recycling centers with the WDOE Certificate of Award (order free from the regional office serving your county. See page 343.)

EXTENDED
LEARNING:

1. Have students make labels for their home recycling containers.

2. Discuss what other groups in the community students might present the kit information to. (Neighbors, other family members, other classes in schools, PTA, school staff, chamber of commerce, city council, mayor, etc.)

PRE & POST
TEST QUESTIONS:

What is "source separation?"

What materials are recyclable?

How do you prepare glass, paper, aluminum and tin for recycling?

How To Recycle Glass

As much as possible, buy returnable or reusable bottles. To prepare glass for recycling, do the following:

1. Wash glass - no need to remove labels.
2. Check with recycler to see if it is necessary to remove all metal caps and rings. Discard caps.
3. Separate glass containers by color, either at home or at the recycling center.

How To Recycle Paper

Newsprint

1. Stack newspapers in a fire-safe area.
2. Check with recycler to see if newspapers should be tied in stacks.

Other Papers

Corrugated cardboard - (two layers of heavy cardboard with a ribbed section in between) Check with your recycler. Flatten for easy storage and transportation. Store in fire-safe area.

Hi Grades - (this is computer paper, tab cards, and ledger paper.)

Check to see what types of paper your recycler accepts.

How To Recycle Aluminum

1. Check to make certain the cans are all aluminum. (See "Some Cans are more Attractive than Others" p. 214.)
2. Rinse. (You may wish to flatten to save storage and transportation space.)
3. Separate aluminum cans from other aluminum products; i.e., TV dinner trays, foil, etc.

How to Recycle Tinned Cans

These are typical food cans - 1% tin, 99% steel.

1. Wash them out and remove labels.
2. Remove both ends and flatten.

How To Set Up Your Home Recycling Center

Setting up and maintaining your home recycling center can be a fast, easy process. The time required per household is about 73 minutes/month - a little more than two minutes per day.

The following are the basic steps for establishing your home recycling center:

1. Find a convenient place in your home or apartment for the center. It doesn't take much room - storage of glass, cans and newspaper for a month usually takes a 3 x 3 foot area. The garage, a storage closet, corner of the kitchen or under the sink are good places.

2. Find sturdy containers to store materials. Three plastic buckets or paper boxes can be used: one for paper, one for cans and one for glass.

3. Locate your closest recycler. Call the WDOE Toll Free Recycling Hotline (1-800-RECYCLE).

   Find out:

   a. if the recycling center is a donation or buy back center.
   b. what materials the center will take.
   c. how you should prepare the recyclables before you bring them in. (e.g., some recyclers require that cans be crushed before you bring them in)

SOURCE: [1]State of Washington, Department of Ecology. Washington State Solid Waste Management Plan. Olympia, WA. 1980.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home. Olympia, Wa.: 1983.

Model Litter Control and Recycling Program. Certificate of Award. Washington State Department of Ecology, 1983.

Go. Dowling-Shepard Productions, 1979, 16 mm., 10 min., color.

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

TITLE: TAKE A LOOK IN YOUR GARBAGE CAN!

USE WITH: What's Garbage to You May Be Gorgeous to Me, p. 47, Nowhere Is Away, p. 31, Take-Home Recycling Kit, p. 229, and Compost -- The End and the Beginning, p. 257.

RATIONAL: The average family garbage can contains predictable types and amounts of waste. Much of this waste is unnecessary, some is reusable and recyclable, and some can be used to create nutrient-rich compost.

SUBJECT: Social Studies, Science, Math

GRADES: 3-6

LEARNING OUTCOME: Students will learn what the average family of four throws away every day and what steps can be taken to reduce the amount of garbage a family generates by reusing and recycling and by composting yard and food wastes.

TEACHER BACKGROUND: On the average, each person in Washington State disposes of 4.6 pounds of waste daily.[1] This figure includes industrial and agricultural wastes. In terms of mixed municipal waste only, citizens of Snohomish County, for example, produce about 3.1 pounds of waste per day.[2]

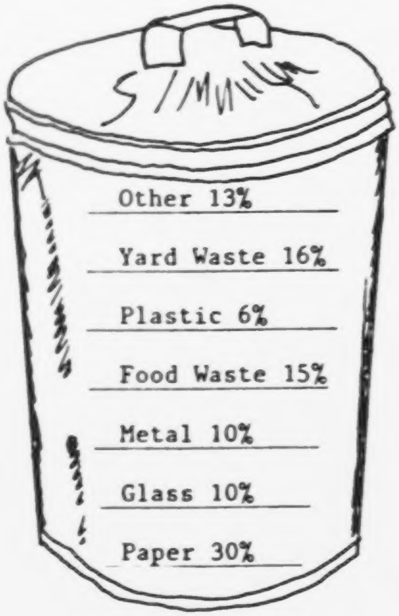
MATERIALS: Heavy cardboard or construction paper
Colored marking pens

LEARNING PROCEDURE:

PART I (Day One)

In this section, you will be showing students what is in the average family garbage can according to weight.

1. Using the heavy cardboard, the teacher will cut seven separate pieces to construct a garbage can. Each piece will be labeled with a category and percentage of garbage. Also, place a number on the back of each piece. Each piece may be brightly colored. (See diagram below)



The Average Family Garbage Can[3]

2. For a second analysis of municipal solid waste, see the table following this activity -- "Components of Municipal Solid Waste, 1975" (Revised 1977).

3. In the classroom, ask students to think about what is in their garbage cans.

4. Place all seven pieces face down on a table and have a student choose piece #1. Have the student show and read what is on the card.

5. The teacher can use the following facts to discuss this garbage category. Follow this procedure for each category of waste.

   A. Paper

      (1) 30 percent of everything we throw away is paper.
      (2) Interesting facts: Roughly 40 percent of all American household refuse is packaging material.[4] Between 1978 and 1980, each American used an average of 580 pounds of paper a year. In 1980, the U.S. recovered 27 percent of the paper it consumed.[5]

      "Paper constitutes fully 50 perecent of the nation's municipal waste by volume." "...Two-thirds of U.S. paper production still ends up in the trash."[6]

      (3) Ask: "What are some of the things that we throw away that are paper?" Some examples are:

         - cereal boxes (open one; if the inside is gray, it was probably made from recycled newspaper)
         - newspaper
         - magazines
         - letters

   B. Glass

      (1) 10 percent of everything we throw away is glass.

      (2) Interesting fact: Of the 46 billion bottles and jars produced in 1981, only one in 15 was eventually crushed to bits and melted down along with fresh material to make new jars and bottles.[7]

      (3) Examples of some things we throw away that are glass:

         - food jars
         - household cleaners and toiletry bottles (i.e. mouthwash containers)
         - beverage containers

C. Metal

(1) 10 percent of everything we throw away is metal.
(2) Interesting facts:

- If you buy beer or a soft drink in aluminum cans, chances are better than fifty-fifty that your can was made from other cans.
- The time between when a can leaving the factory and dropping into the melting furnace once more may be only three months.[8]
- In 1981, on the average, each American used 56 pounds of aluminum. That same year the U.S. recycling rate for aluminum was 32 percent of consumption.[9]

(3) Examples of some things we throw away that are metal:

- old household equipment and appliances
- cans (aluminum, tinned and bimetal)
- metal caps from jars and bottles

D. Food Waste

(1) Up to 15 percent of everything we throw away is food waste.
(2) Interesting fact: The world's largest composting pile, the Netherland's VAM, or Waste Treatment Company, produces approximately 125,000 tons of compost a year. This is sold for farm and garden uses.[10]
(3) Examples of some things we throw away that can easily be used in a compost pile:

- coffee grounds
- egg shells
- nut shells

E. Plastic

(1) 6 percent of everything we throw away is plastic.
(2) Interesting fact: There are many, many kinds of plastic. This is one of the reasons plastic is so difficult to recycle. If all plastic containers were made from the same type of plastic, they would be much easier to recycle.
(3) Examples of some things we throw away that are plastic:

- shampoo and dishsoap containers
- plastic milk bottles
- plastic package wrapping around paper goods, produce bags, and meat packaging.

F. Yard Wastes

(1) About 16 percent of everything we throw away is yard waste.
(2) Interesting fact: Compost piles can reach 140-160 degrees fahrenheit in the center. In cold weather, steam will rise from the pile.
(3) Examples of yard waste we throw away that could be composted:

- hedge clippings
- wood ash
- weeds

G. Other

(1) About 13 percent of everything we throw away does not fall into the other six categories.
(2) Examples of what "other" may be:

- rubber
- textiles (clothing)

PART II (Day Two)

Solutions to Reducing Household Waste

In this section, the teacher will discuss with students how to reduce the waste identified in Part I by recycling and composting. Students will also identify the kinds of materials that go into compost piles.

1. Point out to students that the garbage can is now 100 percent full. Ask students: "What can be done to reduce the amount of waste we have accumulated? The solutions, in addition to revising our buying habits, are:

A. RECYCLING - Recycling is one way to reduce what is thrown out and to conserve energy and natural resources. Go back to the "can" and discuss with students the various ways to reuse or recycle each group of materials. Remove each of the three cardboard pieces that represents the categories that can be easily recycled (paper, glass, metal), thus emptying the garbage can, except for the yard and food wastes, plastics, and "other." Point out that plastics are not easily recyclable and should, therefore, be avoided.

Example: Discuss how paper can be recycled to new paper, but remember to point out other ways to recycle such as simply turning over classroom paper and using the back.

B. COMPOSTING - Yard wastes, such as leaves, grass clippings, and food wastes can be recycled by composting them. Compost is a dark, crumbly, partially decomposed form of organic matter similar in nature to the organic matter in soil. When compost is added to soil, it improves both fertility and soil characteristics. The following portion of this activity will demonstrate to young chlidren what kinds of things go into a compost pile.

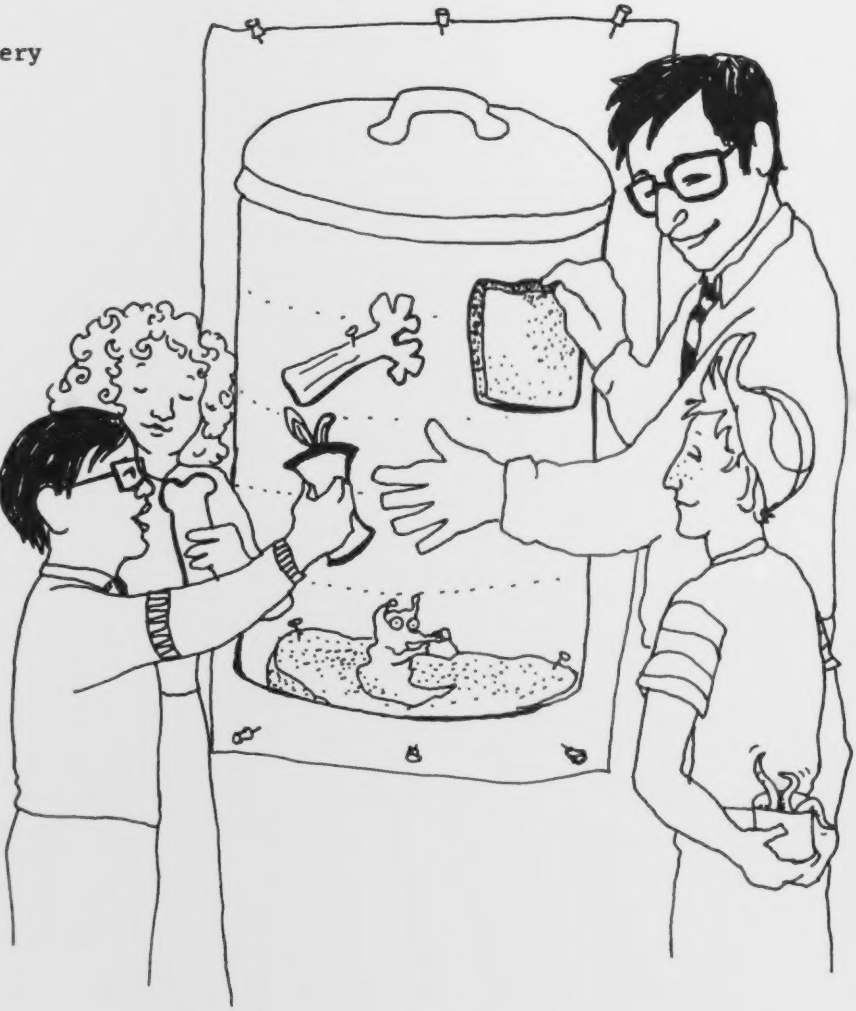
(1) Remove the "food" and "yard" waste labels from the "can" to indicate to students that composting is the way to recycle these items.

(2) Draw and cut out the following representations of organic material, placing a number on the back of each, to "build" a compost pile in the classroom. (The teacher may want students to draw these objects themselves.)

#1 a piece of construction or cardboard paper to represent three inches of dirt

Pictures of:

#2 a piece of celery
#3 an egg shell
#4 an apple core
#5 a layer of leaves
#6 a piece of burnt toast
#7 an over-ripe tomato
#8 a banana peel
#9 coffee grounds
#10 a soup can
#11 a broken cup
#12 any kind of little figure to represent fungus
#13 any kind of little figure to represent bacteria
#14 a big worm



(3) Turn the pieces over and have each student select one piece. Explain to students these pieces are from our food and yard wastes.

(4) Have students place on a table, board, or wall the pieces in the following order to construct a compost pile (now using a garbage can for a good purpose, *see illustration).

   a. #1 (the three inches of dirt) is placed on the bottom. Explain that dirt has enzymes, bacteria, and microscopic animals and plants essential to begin breakdown of wastes. The enzyme action frees nutrients for use by other compost pile dwellers.

   b. #2, 3, and 4 (the celery, egg shell, and apple core) will lie above the dirt as a layer of food.

   c. #5 (the layer of leaves) should lie above the food wastes. This layer adds additional enzymes and bacteria to the pile.

   d. #6, 7, and 8 (burnt toast, tomato, and banana peel) are added.

   e. #9 (coffee grounds)

   f. #11 and 12 (the soup can and broken cup) are examples of items that should not go in the pile, but can be recycled.

   g. Have students place the figures for fungus, bacteria, and the worm in the pile. Worms tunnel in the heap, aerating it. They eat food wastes and help break them down into humus. They eventually die and become part of compost. (If you have an indoor compost pile, you can put in garden worms.)

(5) Now that the compost pile is completed, discuss with students the following additional components of a good compost pile:

   a. Heat - Heat is produced within the compost pile because of chemical reactions caused by the fungus and bacteria. (This heat can reach 140-160 degrees fahrenheit in the center of the heap!). The heat is essential because it sanitizes the compost by killing insect larva.

b. Nitrogen - The organisms that are largely responsible for the breakdown of the organic materials require large amounts of nitrogen. This nitrogen, available from such things as blood meal or nitrogen fertilizer, is necessary for rapid and thorough decomposition.

c. Time - If you want the compost in a hurry, turn it every two or three days and keep it moist. This way you will have humus in three weeks. Otherwise, pile it up and forget it for a year.

(For additional composting information in this curriculum, see Compost - The End and The Beginning, p. 257.)

PART III - Summary

1. Ask:

   a. How much waste did we begin with? (Answer: 100%)
   b. How much did we reduce our waste by recycling? (Total = 50%)
   c. How much did we reduce our waste by composting? (31%)
   d. How much did we reduce our waste by recycilng and composting? (81%)
   e. How much is remaining? (19% -- only "plastics" & "others" remain in the garbage can)
   f. How can we reduce or eliminate plastics and the "other" materials from the waste stream? (By not buying them in the first place.)

PRE & POST
TEST QUESTIONS:

How many pounds of waste do each of us dispose of everyday?

When we fill up the garbage can, approximately what percentage is packaging material? paper? glass? metal? food?

What can we do to reduce the amount of garbage we throw away?

How much does your family pay for your garbage to be picked up?

What materials could be separated from our garbage and reused or recycled?

What materials might a recycler pay for?

SOURCES:

[1] State of Washington, Department of Ecology. *Washington State Solid Waste Management Plan*. Olympia, WA. 1980. p.20.

[2] Fitz, Allen. Resource Recovery Engineer, Snohomish County Solid Waste Division, Everett, WA., 1985.

[3,4] White, Peter T. "The Fascinating World of Trash," *National Geographic*. April, 1983. Vol. 163, No. 4, pp. 424-457.

[5] Waste paper data 1978-80 (Rome: FAO of the U.N., April, 1981) as cited in Worldwatch paper 56. 1983, p. 13 and 14.

[6] Moore, Dennis. "Recycling: Where Are We Now." *New Shelter*. Feb. 1982. p. 59.

[7,8] White, Peter T. "The Fascinating World of Trash."

[9] Fischman, Leonard L. *World Mineral Trends and Supply Problems* (Washington, D.C.: Resources for the Future, 1980)

[10] White, Peter T. "The Fascinating World of Trash."

BIBLIOGRAPHY:

Dindal, Daniel L. *Ecology of Compost: A Public Involvement Project*. Syracuse, N.Y.: Office of Public Service, State University of New York, 1976.

Bem, Robyn. *Everyone's Guide to Home Composting*. New York, N.Y.: Van Nostard Reinhold Co., a Division of Litton Educational Publishing Co., 1978.

Rodale, J. I. *How to Grow Vegetables and Fruits by the Organic Method*. Emmaus, Pa.: Rodale Books, Inc., 1975.

RESOURCES:

Available from the Washington State Department of Ecology. To order see page 343.

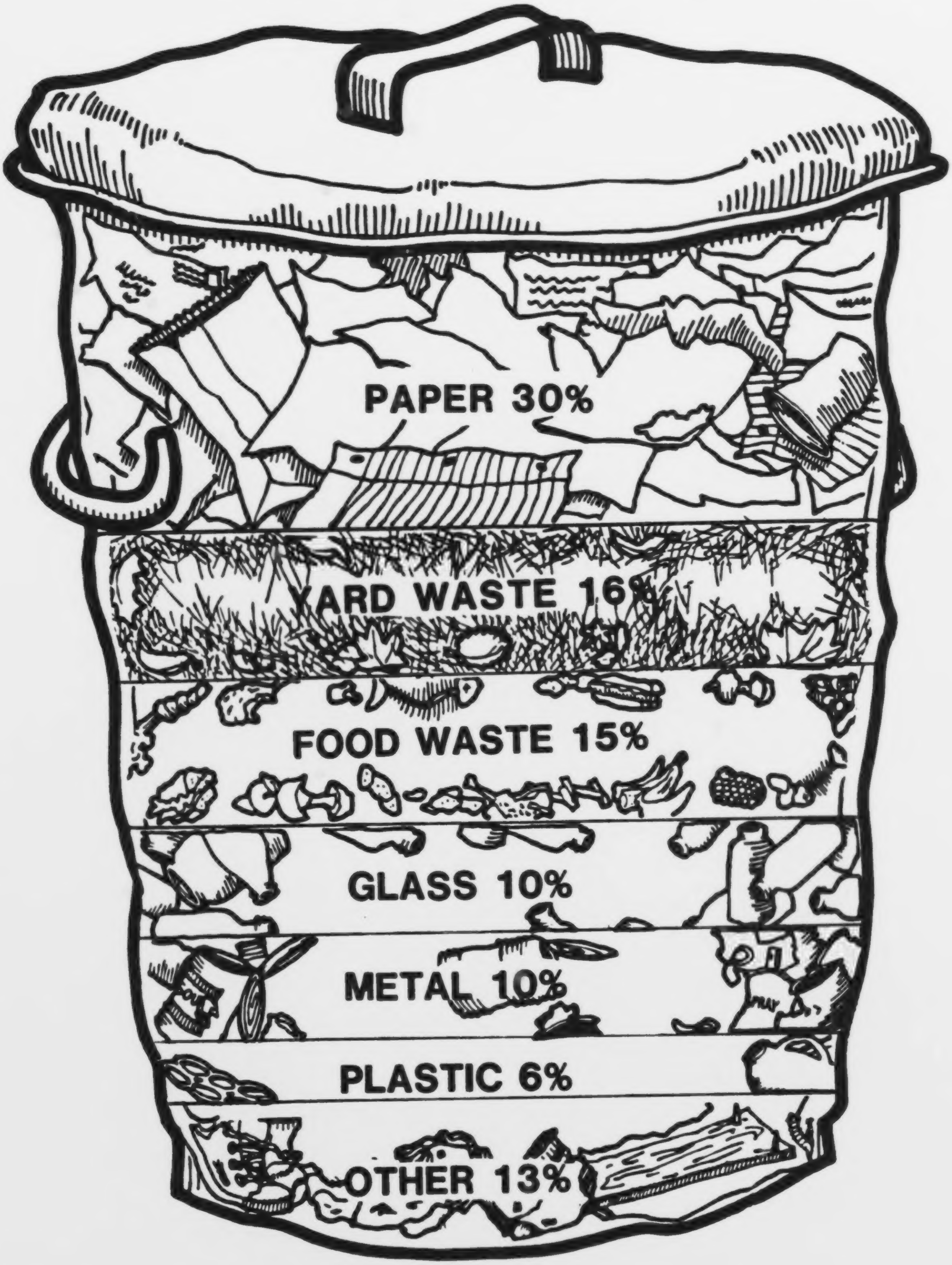
Washington State Department of Ecology. *Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home*. Olympia, Wa.: 1983.

City of Seattle Composting Hotline, 625-2089. Seattle Engineering Department, Solid Waste Utility.

King County Extension Service, 344-7984, 9:00 a.m. to 1:00 p.m. Tape Number 444, "Making a Compost Pile."

Wizard of Waste. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tape, 12 min., color.


PAPER 30%
YARD WASTE 16%
FOOD WASTE 15%
GLASS 10%
METAL 10%
PLASTIC 6%
OTHER 13%

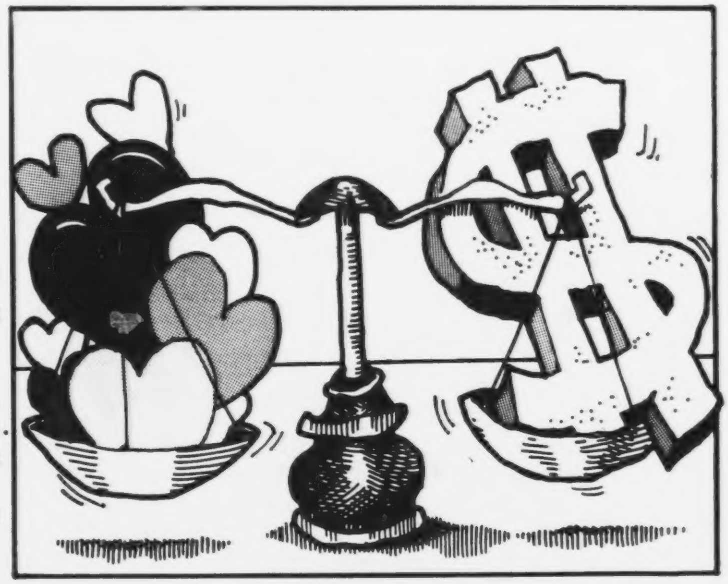
COMPONENTS OF MUNICIPAL SOLID WASTE, 1975*
(Based on wet weights)

Product	% of total waste-generated	
Durable goods		10.9
Major appliances	1.8	
Furniture, furnishings	2.5	
Rubber tires	1.3	
Miscellaneous durables	5.3	
Nondurable goods, excluding food		17.8
Newspapers	6.5	
Books, magazines	2.3	
Office paper	3.8	
Tissue paper, including towels	1.6	
Paper plates, cups	.4	
Other nonpackaging paper	.8	
Clothing, footwear	.9	
Other miscellaneous nondurables	1.5	
Containers and packaging		
Glass containers		9.2
Beer, soft drink	4.7	
Wine, liquor	1.3	
Food and other	3.2	
Steel cans		4.1
Beer, soft drink	1.0	
Food	2.3	
Other nonfood cans	.6	
Barrels, drums, pails, misc.	.2	
Aluminum		0.6
Beer, soft drink	.4	
Other cans	.02	
Aluminum foil	.2	
Paper, paperboard		17.0
Corrugated	9.2	
Other paperboard	4.0	
Paper packaging	3.8	
Plastics		3.3
Plastic containers	.3	
Other packaging	1.6	
Wood packaging	1.3	
Other miscellaneous packaging	.1	
Total nonfood product waste		62.9
Add: Food waste	16.7	
Yard waste	19.2	
Miscellaneous inorganic waste	1.4	
Total		100

* revised January 1977. Details may not add due to rounding.

Source: Fourth Report to Congress: Resource Recovery and Waste Reduction, pp. 14, 17; Office of Solid Waste, Resource Recovery Division, and Franklin Assoc., Ltd., TITLE: THE GOODNESS OF YOUR HEART VS. THE BOTTOM LINE OR WOULD YOU DO IT IF I ASKED YOU? IF I PAID YOU?

USE WITH: Would You Do It If I Taught You? If I Paid You?, p. 72, and Recycling Is Our Business, Is It Yours?, p. 225.



RATIONALE: Education and a sense of responsibility for the health of the environment will increase recycling but immediate financial reward is also a powerful catalyst to action. Sorting and saving recyclables is futile if no place nearby actually recycles the material. For recycling centers to exist there needs to be: (1) a demand for the recycled materials the center collects, and (2) a chance to make a profit in running the recycling center.

SUBJECT: Social Studies, Economics, Business, Environmental Studies

GRADES: 3-12

LEARNING OUTCOME: Student will understand that financial reward -- the profit motive -- plays an indispensable role in making recycling happen. Students will understand that in order for recycling to occur, markets for recyclable materials must be available.

LEARNING PROCEDURES:

1. Make a chart on the blackboard or overhead something like this:

	A Asked	B Paid	C (Optional) Increased Pay
1. White Gloves			
2. Raw Egg			
3. No Pop			
4. Injured Person			
5. Pick up Litter			
6. Recycle			

2. Recording column A responses first, then column B responses, ask such questions as:

   a. Would you wear white gloves to school if I asked you?
   b. Would you wear white gloves to school if I paid you?

   a. Would you eat a raw egg if I asked you?
   b. Would you eat a raw egg if I paid you?

   a. Would you stop drinking pop if I asked you?
   b. Would you stop drinking pop if I paid you?

   a. Would you help someone who was hurt if I asked you?
   b. Would you help someone who was hurt if I paid you?

   a. Would you pick up litter if I asked you?
   b. Would you pick up litter if I paid you?

   a. Would you recycle if I asked you?
   b. Would you recycle if I paid you?

3. Make up your own sets of questions. Consider actually asking students to do some of the above (have a raw egg on hand).

4. Ask: What differences do we see between columns A and B? Why these differences?

   If something is pleasant or good are people more likely to do it when asked? Even more likely if paid?

   If something is stupid, unreasonable, or unpleasant, are people less likely to do it if asked? More likely if paid?

   So if we wanted people to recycle, how could we best get them to do it? Educate people about the importance of recycling? Pay people for recycling?

   What about people who run recycling centers, why do they do it? What do these people need in order to keep running their business? What would happen if they had no one to sell recyclables to?

   What has to exist in order for a recycler to sell recyclables?

   If sufficient markets for recyclables do not now exist but the public demands that more waste be recycled rather than dumped in landfills or burned, should government help create markets for recyclables? What are some things government can do to stimulate recycling? Are there problems if government subsidizes recycling? What should government do?

PRE & POST
TEST QUESTIONS:

What is the best way to motivate people to recycle and to operate recycling centers?

RESOURCES: Available from the Washington State Department of Ecology. To order see p. 343.

"Recycling in Washington" slide show and narrative, 15 minutes, color. 1983.

TITLE: DISNEYLAND IT AIN'T: FIELD TRIPS TO A RECYCLING CENTER, LANDFILL OR TRANSFER STATION

USE WITH: Recycling is Our Business, Is It Yours, p. 225, Deciding Where It's Going to Go, p. 142.

RATIONALE: Valuable energy and finite natural resources are lost forever when solid waste is dumped in landfills.

SUBJECT: Contemporary Problems, Social Studies, Business, Home Economics

GRADES: 3-12

LEARNING OUTCOME: Students will be able to observe and contrast the difference between recycling and dumping solid waste. Students will learn some of the economic aspects of recycling. Students will understand that dumping solid waste in a landfill is a high cost loss of natural resources. Students will understand why landfills are hard to site and, at least for now, necessary.

LEARNING PROCEDURE:

1. Arrange a class visit by a local recycler or a visit to a recycling center to understand its operation. Contact the WDOE Recycling Hotline, 1-800-RECYCLE for names and numbers of recyclers in your community. Also invite a city or county solid waste manager to explain how waste is managed in your area.
2. On a county or city map, locate transfer stations and landfills.

   Ask: Why do you think the landfill was built here? What things need to be considered before building a landfill? Who decides where landfills are built?
3. Prior to the field trip, discuss safety precautions, rules, and regulations governing recycling centers, landfills, or transfer stations.
4. Students should take a check sheet to inventory items seen at the landfill -- record numbers and varieties of items that could have been recycled. They should also make a list of other items they consider valuable, that could have been reused or that revised consumer habits would have prevented from reaching the landfill. How many items contain finite natural resources?
5. Have students prepare a comparison list between landfills and recycling centers.

   a. Landfill

      - you pay to dispose of waste
      - receives a wide range of unseparated waste
      - run by government

- involves using large portion of land for a single purpose
- may pose environmental/health problems such as ground water pollution
- affects the surrounding community with noise, litter, traffic, birds
- resources in solid waste are lost forever
- currently appears to be the cheapest method of garbage disposal
- can accommodate enormous quantities of waste

b. recycling center

- you may be reimbursed for recycling your waste
- receives a range of waste for recycling and reuse
- privately run
- uses comparatively little land for business, if properly managed, the center poses no serious problems for public health
- compared to a landfill, the environmental impact on the community is modest
- may not be close enough to provide economic reward

PRE & POST
TEST QUESTIONS:

What does a recycler do in his business?

What are the advantages of recycling as opposed to dumping waste in a landfill?

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You, Elementary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1980.

California Energy Extension Service. The ABC's of Recycling. 1211 - 16th St., Sacramento, Ca. 95814.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home. Olympia, Wa.: 1983.

Garbage. Educational Media, 1969, 16 mm. 10½ min., color.

Closing the Loop. California Solid Waste Management Board, 1980, Filmstrip/tape, 10 min., color.

The Trash Monster. California Solid Waste Management Board, filmstrip/cassette tapes, 12 min., color.

TITLE:	GRAPHING PRICES FOR RECYCLABLES
USE WITH:	The Goodness of Your Heart vs. the Bottom Line, p. 244, and Recycling is Our Business, Is it Yours?, p. 225.
RATIONALE:	Continuing and comparative studies may be done to find the most profitable place to take recyclables.
SUBJECT:	Math
GRADES:	6-9
LEARNING OUTCOME:	Students will graph a comparative and continuing study of the prices for recyclables.
MATERIALS:	Graph paper Transparencies
LEARNING PROCEDURE:	NOTE: Depending on the grade level, students may need to know how to make a graph and be shown examples of different kinds of graphs.

1. Discuss what is recyclable.

2. Call various recyclers for prices they are currently paying for recyclables. Call the Toll Free WDOE Recycling Hotline (1-800-RECYCLE) for the names and numbers of recyclers near you.

   Ask recyclers what factors influence the price paid for recyclables. List.

3. Graph the information by:

   a. Type of material:

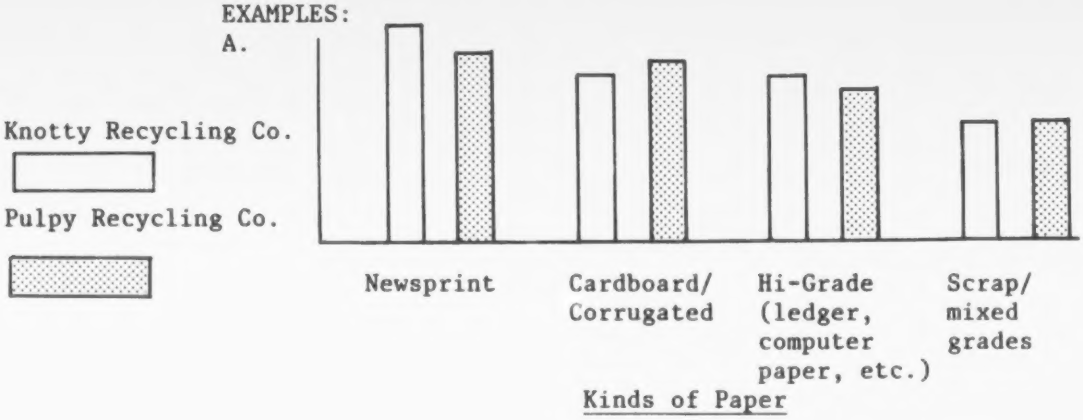
      - glass - returnables, other glass
      - paper - newsprint, cardboard, white ledger, scrap grades
      - metals - tin cans, bi-metal cans, aluminum cans, other metals

   b. Prices being offered by recyclers.

4. Study price changes on a monthly basis.

EXAMPLES:

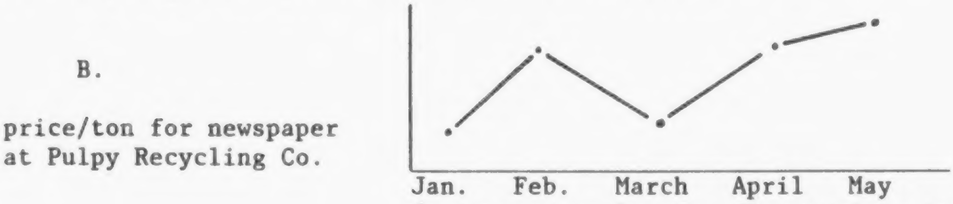
A.



5. Using the graphed information, which recyclers pay the most? If the prices are the same, discuss why this is so.

6. Why might the price vary from month to month?

B.



(contact recycler for fluctuations in price over time)

PRE & POST
TEST QUESTIONS:

Do some recyclers pay more than others for materials?

Do prices change from month to month?

What factors might influence prices paid for recyclables?

BIBLIOGRPAHY: Ohio Department of Natural Resources. Looking Good in Ohio's Schools. Columbus, Ohio: Office of Litter Control, 1982.

Western Regional Environmental Education Council. Project Learning Tree. The American Forest Institute, Inc., 1975.

TITLE: ORGANIC FERTILIZERS

RATIONALE: Some industrial and commercial organic wastes can be recycled into effective fertilizers.

SUBJECT: Science, Horticulture

GRADES: 7-10

LEARNING OUTCOME: Students will rate the effectiveness of various organic and inorganic fertilizers.

MATERIALS: Stock amounts and solutions of:

- Fish fertilizer
- Algae
- Rabbit "tea" - bag of rabbit manure and water
- Planting soil
- "Garden Thriller" a homemade organic fertilizer, made up of bloodmeal, bonemeal, phosphate rock, hybrodite granite, and kelp.
- Any balanced organic fertilizer.
- Per student:
    - 6 - Bean seedlings ready for transplanting
    - 6 - Pots

LEARNING PROCEDURE: Three weeks prior to the rest of this activity, have students germinate bean seeds. When plants are ready for transplanting, pick ones of equal health to fertilize. Add recommended doses of fertilizer from stock solutions. Maintain one control per group of six.

- Have students state hypotheses about the effect of fertilizer on plant growth.
- Discuss the nutrients in each fertilizer.
- Emphasize the recycled origin of most of these fertilizers.
- Discuss solubility and residuality of fertilizers.
- Discuss measurement of growth (height, number and color of leaves, roots, etc.).
- Record results once per week for four weeks.
- (Number fertilizers: Don't tell students which plant corresponds with which fertilizer. This makes the experiment exciting and more valid.)
- Have students water all plants at the same time, with the same amount.)
- Have class compile results after one month.
- Discuss accuracy of class results vs. individual results.
- Determine rating scheme and reveal the winner.
- Discuss what other recycled materials could be used for fertilizer.

PRE & POST
TEST QUESTIONS:

Name three kinds of fertilizers suitable for growing beans from seed. Which would you choose? Why?

What are fertilizers made of?

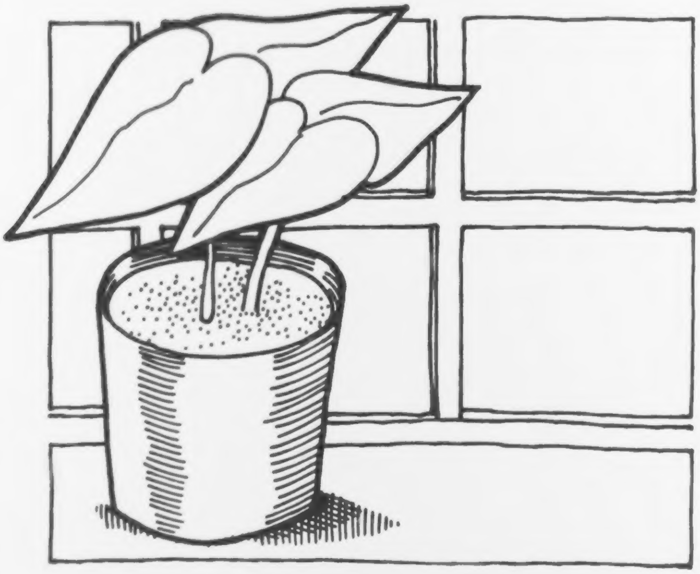
How is fertilizing a form of recycling?

What does "organic" mean?

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.

Rodale, Robert, Ed. The Basic Book of Organic Gardening. New York, N.Y.: Bobbs-Merrill Co., 1975.



TITLE: NONRENEWABLE RESOURCES: HOW LONG WILL THEY LAST?

RATIONALE: There is a limit to how long more and more of us can continue to make increasing demands on our finite resources. Concentrated, easily mined reserves of nonrenewable resources are being depleted. The availability of these resources can be extended by careful use and recycling. (NOTE: This activity highlights nonrenewable natural resources other than the fossil fuels.)

SUBJECT: English, Social Studies (Geography, Contemporary Problems)

GRADES: 7-12

LEARNING OUTCOME:

1. Students will learn the estimated life expectancies of selected nonrenewable natural resources.

2. Students will understand the role recycling plays in meeting the demand for certain nonrenewable resources.

3. Students will understand the role careful use might play in extending the availability of selected natural resources.

TEACHER BACKGROUND: "The global demand for and consumption of most major nonfuel mineral commodities is projected to increase 3-5 percent annually, slightly more than doubling by 2000."[1]

LEARNING PROCEDURE:

Examine the chart "Selected Nonrenewable Natural Resources; Their Life Expectancies & Prime Consumers."

1. Which column under the heading "Life Expectancy in Years" do you think is more accurate in estimating the length of time our nonrenewable natural resources will last? What are some factors leading to the accelerated use of resources?

2. Examine the "static use" column under the heading "Life Expectancy in Years." Which nonrenewable natural resource will be used up first?

   Ask: Which countries have the highest reserves of the resource? Locate these countries on a world map.

   Ask: Why does the U.S.A. need to be concerned with the depletion of this resource?

3. Which nonrenewable resource will last the longest according to the static index? According to the projected rates index?

Ask: Which countries have the highest reserves of this resource?

Ask: With which countries will the U.S.A. need to cooperate in order to get the amount of this resource it needs?

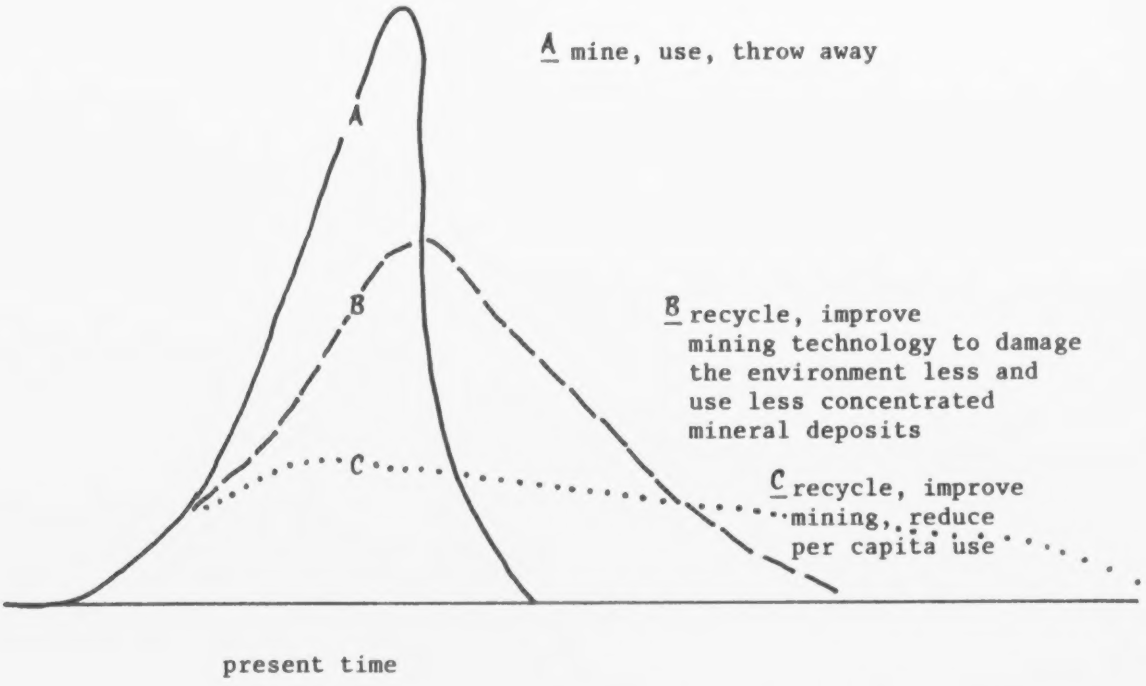
4. Which resource is most extensively recycled? List items you use that contain this resource. Which of these items could you recycle?

5. List the resources that will probably be used up within the next 40 years given projected use rates.

Ask: What role do recycling and careful use play in extending the availability of these resources?

The following graph illustrates three possible depletion patterns for a nonrenewable natural resource. Pattern A shows that a rapidly expanding use of a resource without improved mining technology and increased recycling will lead to exhaustion of available quantities of that resource. Patterns B and C illustrate that this rapid rate of depletion can be significantly slowed by improved mining technology that can exploit less concentrated mineral deposits, by reduced per capita use, and by increased recycling.

ALTERNATE DEPLETION PATTERNS FOR A NONRENEWABLE RESOURCE[2]
(modified after Hubbert 1962 and Cloud 1971)



Selected Nonrenewable Natural Resources; Their Life Expectancies & Prime Consumers

Resource	A. 1982 Estimates of Reserves	B. Countries or Areas with Highest Reserves*		C. Prime Consumers 1974		D. Life Expectancy in Years		E. Amount Recycled 1982
						Static Use at '76 Level	Use Growing at Projected Rates	
Aluminum in Bauxite	5610 million short tons short ton = 2,000 lbs.	Guinea Australia Brazil Jamaica	26% 26% 15% 6%	U.S.A. U.S.S.R.	42% 12%	312	63	950,000 tons old scrap recycled (about 20% of apparent consumption). Approx. 950,000 tons of new scrap (also known as "prompt industrial scrap") were recycled.
Copper	511 million metric tons metric ton = 2,200 lbs.	Chile U.S.A. U.S.S.R. Zambia	19% 18% 7% 6%	U.S.A. U.S.S.R. Japan	33% 13% 11%	63	36	Old scrap - 500,000 tons New scrap - 675,000 tons
Gold	1330 million troy ounces	Rep.of S.Africa Centrally Planned (Communist) Economies U.S.A.	53% 20% 8%					Old scrap - 1.4 mil. troy oz. New scrap - 1.3 mil. troy oz.
Iron in Ore	108 million short tons	U.S.S.R. Brazil Australia Canada U.S.A.	29% 20% 11% 9% 5%	U.S.A. U.S.S.R. W. Germ.	28% 24% 7%	172	62	There is no significant recycling of iron ore, although iron and steel are recycled as scrap.
Lead	146 million metric tons	U.S.A. Australia Canada	17% 16% 15%	U.S.A. U.S.S.R. W. Germ.	25% 13% 11%	37	25	Old scrap - 540,000 tons
Silver	8400 million troy ounces	U.S.A. Canada Mexico	21% 19% 13%	U.S.A. W. Germ.	26% 11%	20	17	Old scrap - 28 million oz.
Tin	11,000 million short tons	Indonesia China Thailand Malaysia	16% 15% 12% 12%	U.S.A. Japan	24% 14%	41	31	Old scrap - 11,000 tons New scrap - 3,000 tons

*Reserves extractable now or that have a reasonable potential for becoming economically available.

Sources: Columns A & B - U.S. Bureau of Mines, 1983 Mineral Commodities; Column C - Wilson Clark, Energy for Survival; Column D - Global 2000 Report; Column E - U.S. Bureau of Mines, Mineral Commodities.

How can we determine how long a given resource might last? Any projections are based on two major sets of assumptions: We must estimate the potentially available supply at existing (or future) acceptable prices and with existing (or improved) technology, and we must estimate the annual rate at which the resource may be used.

"There is no danger whatever of humanity "running out" of nonfuel mineral resources, and I have not said there is. Humanity is not destroying them. What will run out, however, is the capacity of the environment to absorb the punishment associated with mining ever-lower grades of ore or reconcentrating what is already dispersed. Secondarily, the ability to do the job at an attractive cost will also 'run out'."[3]

SOURCES:

[1] Council on Environmental Quality. Global 2000 Report to the President: Entering the 21st Century, vol. 1, Summary. U.S. Gov't Printing Office, Washington, D.C. 20402.

[2] Miller, G. Tyler, Jr. Living in the Environment. Concepts, Problems, and Alternatives. Wadsworth Pub., Belmont, California, 1975 and Revised Edition 1982.

[3] Erlich, Paul. "Social Science Quarterly" Vol. 62, No. 1, March 1981.

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You Elementary Guide. Seattle, WA: Washington State Office of Environmental Education, Northwest Section, 1980.

TITLE: COMPOST - THE END AND THE BEGINNING

RATIONALE: Recycling by composting improves soil structure and fertility and reduces the volume of household solid waste.

SUBJECTS: Biology, Horticulture, Vocational Agriculture

GRADES: 7-12

LEARNING OUTCOME: Students will learn the basic principles necessary to construct a good compost pile. Students will understand how composting reduces household waste.

MATERIALS: Organic waste (manure), soil, five-five gallon buckets, thermometer.

LEARNING PROCEUDRE:

1. Read about composting and the alternatives for construction of compost bins or containers. (See Resources at the end of this activity for some good book suggestions. Choose the methods which are within your time and budget limitations.)

2. Using grass clippings, manure, weeds, hay, sawdust, coffee wastes, etc., start five small experimental compost piles. Make sure not to include bones, meat, grease or other materials that may attract rodents and pests. Try to keep compost piles about one cubic yard, or if necessary, use five 5-gallon buckets with holes drilled in the sides.

3. Each compost pile will be unique in one of the following ways:

   The five experimental conditions:

   a. Low in nitrogen

      - no manure or garbage that is high in nitrogen.
      - moisten, don't soak.
      - turn over regularly, every 3-4 days at first, then once a week.
      - include a mixture of ingredients: garbage, clippings, leaves, weeds, etc.

   b. Not enough moisture

      - include manure and contents which are high in nitrogen.
      - turn regularly.
      - have a good mixture of ingredients.
      - don't water at all and make an effort not to add garbage that has a lot of moisture in it.

c. No air circulation

- include nitrogenous materials.
- good mixture of ingredients.
- keep moist.
- do not stir.

d. Too much of a single ingredient

- put all leaves or grass clippings in this pile.
- moisten.
- stir regularly.

e. Good compost pile

- include nitrogenous material (manure and blood meal are good sources).
- keep moist.
- stir regularly.
- include a good mix of ingredients which are layered.

Keep a daily record of the temperature of each pile.

After a few weeks discuss the results. Why does one pile break down wastes faster than others? What are the essential ingredients of a good compost system?

Discussion questions:

How is the compost pile like the nitrogen cycle and other natural cycles in our biosphere? (The nitrogen cycle is "the continuous cyclic progression of chemical reactons in which atmospheric nitrogen is compounded, dissolved in rain, deposited in the soil, assimilated, and metabolized by bacteria and plants and returned to the atmosphere by organic decomposition."[1]

Where is composting occurring naturally?

What are consequences of not recycling vital chemicals to their origins?

PRE & POST
TEST QUESTIONS:

What is composting?

What are the necessary "ingredients" for a good compost pile?

How is composting related to the concept of recycling?

How can composting reduce waste?

SOURCE: [1]Webster's II New Riverside University Dictionary, Boston, MA, Houghton Mifflin Co., 1984.

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.

Dindal, Daniel L. Ecology of Compost: A Public Involvement Project. Syracuse, N.Y.: Office of Public Service, State University of New York, 1976.

Rodale, Robert, Ed. The Basic Book of Organic Gardening. New York, N.Y.: Bobbs-Merrill Co., 1975.

Organic Gardening and Farming Staff and Ed. "The Compost Heap that Grew into the 14-Day Method," Calendar of Organic Farming: A Guidebook to Successful Gardening Through the Year. Emmaus, Pa.: Rodale Press, Inc., 1973.

City of Seattle Composting Hotline, 625-2089, Seattle Engineering Department, Solid Waste Utility.

King County Extension Service, 344-7984, 9:00 a.m.-1:00 p.m. Tape Number 444, "Making a Compost Pile."

TITLE: CLOSING THE LOOP - This activity accompanies the ten-minute filmstrip "Closing the Loop," (A good follow-up activity is Industry Recycles, p. 262. Filmstrips available from the Washington State Department of Ecology - see page 343.)

USE WITH: Industry Recycles.

RATIONALE: Recycling "closes the loop" between consumers and industry and prevents natural resources from being lost in landfills.

SUBJECTS: Math, Science, Social Studies, Government, Contemporary Problems

GRADES: 9-12

LEARNING OUTCOME: Students will learn what materials are recyclable, how recyclers process materials for reuse, and the volumes of resources that recycling could potentially conserve in a community.

LEARNING PROCEDURE:

1. View the Filmstrip.
2. List 4 commonly recycled materials.
3. Determine the population of your community.
4. Using the following data provided in the filmstrip for Modesto, California, determine approximate volumes of materials your community would conserve and how much money would be saved in garbage collection fees by recycling for a year. Also determine how much money could potentially be made by selling these materials to recyclers. (For prices, contact the WDOE Toll Free Recycling Hotline (1-800-RECYCLE) for names and numbers of recyclers in your community.)

   If everyone in Modesto, California (population 81,000) recycled for one year:

   - 2 acres of landfill area would be saved
   - \$6 million would be eliminated from collection costs
   - \$125,000 would be paid to people for their recyclables
   - 810,000 lbs. of bauxite would be conserved
   - 3,600,000 lbs. of iron ore would be conserved
   - 400,000 lbs. of tin would be conserved

- 2,000,000 lbs. of silica would be conserved
- 62,000 trees would be conserved

PRE & POST
TEST QUESTION:

If everyone in your community recycled for one year, what approximate volumes of materials would be conserved

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Closing the Loop. California Solid Waste Management Board, 1980, Filmstrip/tape, 10 min., color.

272

TITLE: INDUSTRY RECYCLES - This activity accompanies the ten-minute filmstrip "Industry Recycles," available from Washington State Department of Ecology.

USE WITH: Closing the Loop, p. 260

RATIONALE: By recycling, some industries are able to save money and conserve resources.

SUBJECT: Science, Social Studies, Government, Contemporary Problems

GRADES: 9-12

LEARNING OUTCOME: Students will learn some of the industries that recycle and how industrial wastes are used by industry and the public.

LEARNING PROCEDURE:

1. View the film "Industry Recycles."
   - List three industries that recycle and explain what materials they recycle.
   - Describe two benefits gained by industry from recycling.
2. Answer the following questions:
   - What can be done with sludge?
   - What can be done with sludge ash?
   - What is a waste exchange? Why might it be valuable in a community?
   - Why may recycling be done efficiently by industries?
   - Is there an industry in your community that recycles?
3. Call the public relation manager of a local company to ask what the company recycles and how the recycling is done.
4. What future career opportunities do you see related to industrial recycling?

PRE & POST TEST QUESTIONS:

List several industries that recycle and what they recycle.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Industry Recycles. California Solid Waste Management Board, 1980, Filmstrip/tape, 9 min., color.

TITLE: TOOL REPAIR

RATIONALE: Repairing and reusing can conserve energy and resources and can generate money.

SUBJECT: Industrial Arts, Horticulture, Vo-Tec.

GRADES: 10-12

LEARNING OUTCOME: Students will learn simple repair techniques in order to extend the life of useful equipment and reduce the use of natural resources, the loss of energy, and the cost of landfilling.

MATERIALS: Broken tools, repair equipment: pliers, hammer, drill, files, saw, etc.

LEARNING PROCEDURE:

1. Collect broken tools.
    - a. Ask students to donate broken tools from home, friends, etc.
    - b. Put an ad in the local paper stating that you are collecting old tools for educational purposes.
    - c. Look through junk stores and garage sales for fixable items.
    - d. Contact your local recycler. Check to see if he has broken tools.
2. Buy or make new handles for tools you have received.
3. For more extensive repairs, the use of the school shop equipment may be needed. Most repairs can be made using pliers, hammer, drill, files, and a saw. Cost will run, on the average, 25 percent of the cost of a new tool.

    Example of tool repair: Garden spade with broken handle.

    Buy a new handle, making sure a rivet is included. Burn out the remainder of the handle and drill out the rivet that holds it. Line up the new handle and shove it as far as you can into the hole of the blade. Then, place the handle on a woodblock and drive the blade down with another woodblock until you get a tight fit. Drill through the rivet hole and insert the rivet and peen the end down.

EXTENDED LEARNING: In addition to tools, small household appliances, small gas engines, and electrical equipment can be repaired in Industrial Arts classes.

PRE & POST TEST QUESTIONS:

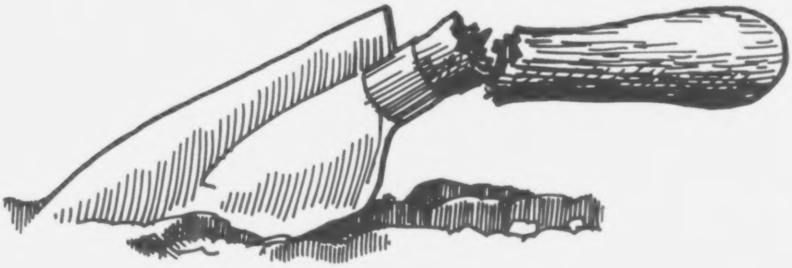
What cost savings might there be in repairing tools rather than purchasing replacements?

List some of tools that are often thrown away that could be repaired.

What is planned obsolescence? How is the concept related to waste?

BIBLIOGRAPHY: Peterson, Christina, et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Washington State Office of Environmental Education, Northwest Section, 1983.

"Old Garden Tools Get a Fresh Start," Sunset. April, 1969.



TITLE: THE END OF THE ROAD

USE WITH: The Throwaway Three, p. 79

RATIONALE: More than half of American waste is recyclable. Denmark, for example, recycles 60 percent of its waste.[1]

SUBJECT: Drama, Social Studies, Language Arts.

GRADES: 6-10

LEARNING OUTCOME: Students will write the script for a play, which they will also perform, to encourage consumers to recycle cans, glass, and paper and to reuse nonrecyclable items.

MATERIALS: Backdrop of a typical American kitchen.

Scene 1 Props: Papers, cans, bottles and large plastic bags.

Costumes: Al Can, Jill Jar, and Patty Paper.

Scene 2 Props: Box, cans, bottles, paper, plastic milk jug.

Scene 3 Props: Plastic milk jugs cut as planters, storage containers, and wall decorations.

Costumes: Al Can, Jill Jar, and Patty Paper.

LEARNING PROCEDURE: Using the information provided in the following skit, the students will actually write the script and perform the play for elementary students.

Scene I Mae and Will Waste's kitchen on Evermore Drive. Mae and Will are overstuffing big plastic garbage bags with papers, cans, and bottles.

Mae laments the TV commercials which say the garbage bags will not break. She feels they never hold enough. Will reminds her that trash is piled four feet deep in plastic bags all through their backyard, and that no more waste will fit out there. Mae longs for the good old days when the landfill was open and the big truck came and picked their garbage up every week. Will says the landfill had to fill up eventually, and that there is no "away" anymore. While Will leaves to take the trash out, Mae is greeted by a strange looking creature named Al Can. Al is sad because he is in his prime, feeling strong and vigorous, but instead of putting him to work, they are throwing him away. Al claims to have part of the solution to their trash problem. He says all those aluminum cans they have been throwing away are very valuable. If they collected their aluminum cans, they would not only make money, but would also cut down on their trash. Mae is delighted and calls Will. Will laughs at her, telling her he never heard of a talking can. After Mae leaves, Will is confronted by a glass jar named Jill. The jar tells him that glass is valuable and that if he would collect all his glass jars and bottles and take them to the recycling center, he would make some more money. She asks him to think about the heat and energy that it took to make her lovely shaped clear exterior, and that it would be a shame to waste all of that by throwing her away. When Mae returns, they are both confronted by Patty Paper who wants to be used again. She states she's tired of lying around, she still feels young and there's a lot of life in her yet. She doesn't want to go "up in smoke." Mae and Will decide to collect their cans, glass bottles, and papers and take them to the local reycling center.

Scene II Later, Will and Mae are excitedly discussing what they will do now that they have a clean yard and some extra money. Will wants to grow a garden so they don't have to buy so much food. Mae is thinking of setting up a recycling center in the kitchen. She recycles cans, bottles, and paper but doesn't know what to do with her plastic milk jugs. She thinks and thinks.

Scene III Will and Mae are happy at last. They no longer have piles of trash and they have used their plastic milk jugs as planters, storage containers, and wall decorations.

They are joined on stage by Patty, Jill, and Al. They are now all happy that Patty, Jill, and Al are useful and valuable, and no longer just trash. They have made their world and ours a better place.

Mae and Will tell the kids about the local recycling center and ask them to get their parents involved for the sake of Patty, Jill, and Al.

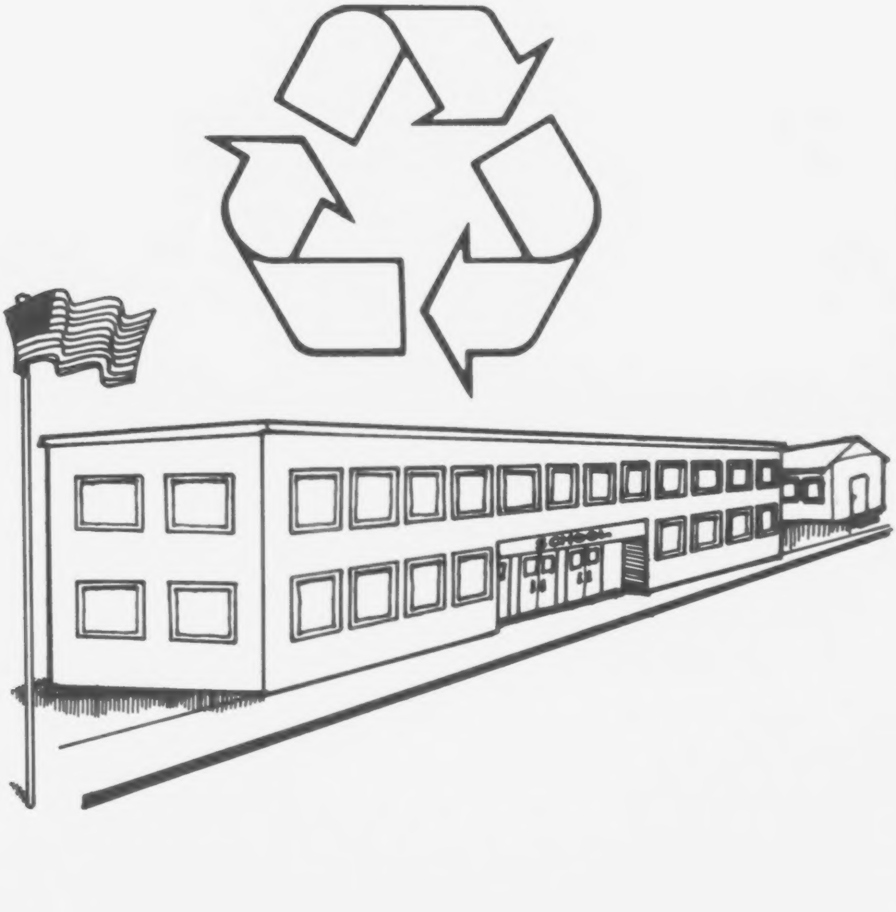
SOURCE: [1]Moore, Dennis. "Recycling: Where Are We Now?" New Shelter. Feb., 1982. p. 58.

RESOURCES: Available from Washington Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home. Olympia, Wa.: Washington State Department of Ecology, 1983.

2-cubic-foot bags for recycling.

SCHOOL RECYCLING PROGRAM



TITLE: SPEAK UP FOR RECYCLING

RATIONALE: Organizing a speech in terms of thesis and support is an effective way to present a persuasive argument.

SUBJECTS: Speech, Language Arts

GRADES: 5-12

LEARNING OUTCOME: Students will present a persuasive, well-organized thesis and support speech advocating the establishment of a school recycling program.

LEARNING PROCEDURE: To develop a thesis and speech, students will:

1. State possible thesis statements.
2. Rework possible statements to produce a positive, succinct thesis statement.
3. Brainstorm reasons supporting this thesis.
4. Rate reasons in the order in which they will be presented: least persuasive to most persuasive.
5. Write a short introduction to the speech. Introduction includes: introduction of self, short history of situation or problem at hand and ends with a statement of thesis.
6. Write short transition phrases leading from one reason to the next to give speech continuity.
7. Write summary/conclusion that restates the problem, summarizes the most persuasive reasons, restates the thesis in a new way and leaves the audience with an important point to consider.
8. Transcribe the speech onto note cards, one main point per card.
9. Practice the speech so that students can deliver it smoothly, not reading the cards but using them only for reference while looking at their audience and feeling prepared for speaking in public.

EXTENDED LEARNING: Students present thesis and support speech to community groups, city council, county commissioners.

Students attend public meetings on other public problems and evaluate the effectiveness of the presentations.

Students attend trials and court hearings to evaluate techniques and effectiveness of presentations.

Teacher arranges visits of lawyer to class to discuss techniques of persuasive speaking.

Students write letter to the editors of local papers advocating recycling as a community method of solid waste management.

Students debate recycling vs. "resource recovery" as solid waste management options.

Have student leaders suggest waste reduction, recycling, and waste burning as issues for the student legislative session held yearly in Olympia.

PRE & POST
TEST QUESTIONS:

What is a thesis statement?

What criteria can be used to judge the effectiveness of speeches and speakers?

Brown's
RECYCLING
CENTER

TITLE: LOGOS AND SLOGANS FOR RECYCLING

RATIONALE: Logos and slogans are valuable in the promotion of a school recycling program.

SUBJECT: Art

GRADES: 6-12

LEARNING OUTCOME: Students will create a slogan and design a logo for posters promoting the school's recycling program.

WASTE WATCHERS
RECYCLE
SNOHOMISH COUNTY
Solid Waste Management

LEARNING PROCEDURE:

1. Study examples of well-known logos and slogans. Try to include the logos and slogans of this and other states' litter and recycling programs.
2. Discuss how these logos and slogans represent the values of the product or organization being promoted.
3. Summarize the values of logos and slogans. For example:
    a. They attract attention.
    b. They promote a program with simple symbolism.
    c. They stimulate instant recall.
    d. They are attractive.
    e. They enhance feelings of identification with the program.
4. Discuss the values the students want their logos and slogans to promote.
5. Draw the logos and write the slogans.
6. Choose the favorite logo and favorite slogan. Reproduce them in poster form and display the posters in the school, community, and recycling center.

EXTENDED LEARNING:

1. Provide awards for the best posters.

2. Sell T-shirts with the logos printed on them.

PRE & POST TEST QUESTIONS:

How may logos and slogans help advertise recycling?

List three slogans and three logos and the companies or products they represent. Are they effective? Why do you remember them?

BIBLIOGRAPHY: Ohio Department of Natural Resources. Looking Good In Ohio's Schools. Columbus, Ohio: Office of Litter Control, 1982.

Noble, Valerie. The Effective Echo: A Dictionary of Advertising Slogans. New York, New York: Special Libraries Association.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Model Litter Control and Recycling Program. Certificate of Award. Washington State Department of Ecology, 1983.

WASHINGTON STATE
DEPARTMENT OF ECOLOGY
LITTER CONTROL & RECYCLING PROGRAM

CLEAN UP OHIO
LITTERALLY

Virginia Division
of Litter Control
1215 Washington Building
Richmond, Virginia 23219
804-786-8679

TITLE: THE ART OF SOLID WASTE

USE WITH: Finders, Keepers: Found Object Collage, p. 198, and Poster Facts, p. 115.

RATIONALE: Solid waste may be used to create art work advertising a school recycling program.

SUBJECTS: Art, Advertising

GRADES: 6-12

LEARNING OUTCOME: Students will be able to use solid waste in an artistic manner to advertise the school recycling program.

LEARNING PROCEDURE:

1. Conduct a discussion on seeing artistic qualities in everyday items: line, form, elements of design, etc.
2. Research, and use as examples, works of art by artists who have used everyday items in their artwork.
3. Discuss how reducing our solid waste problem requires that people look at waste in new and creative ways.
4. Students collect for three days to one week all the potentially recyclable items that they normally would throw away, such as aluminum cans, bottles, paper, and plastic milk bottles.
5. Bring these items to class.
6. Using their own garbage (solid waste) students make a collage (poster size) or sculpture advocating the need to recycle. (All students may work together to create one large sculpture.)
7. Select titles for each piece to advertise the recycling program. Display at recycling station in your own school or other recycling centers in the community.

EXTENDED LEARNING: Show students photos of sculpture made from waste in the National Geographic article of April, 1983 "The Fascinating World of Trash."

Using photographs such as those found in the collection "Stop, Look and Write," discuss and analyze new ways of looking at an ordinary object.

PRE & POST
TEST QUESTIONS:

How can art, advertising, and recyclable waste materials be used to promote a recycling program?

BIBLIOGRAPHY:

Leavitt, Hart Day and David A. Sohn. Stop, Look and Write: Effective Writing Through Pictures. New York, New York: Bantam Books, 1964.

White, Peter F. "The Fascinating World of Trash," National Geographic, April, 1983. Vol. 163, No. 4. pp 424-457.

Ekstein, Artis Aleene and Alice R. Shannon. How to Make Treasures from Trash. Greatneck, New York: Hearthside Press, 1972.

Meilach, Don Z. Creating Art From Anything. Chicago: Reilly and Lee, 1968.

TITLE: MANUFACTURING A "CAN CRUSHER"

RATIONALE: Economic rewards encourage an increased participation in recycling.

SUBJECT: Industrial Arts

GRADES: 7-9

LEARNING OUTCOME: Students will learn the value of recycling as well as learning how to plan a simple product, mass produce the product, and market it.

MATERIALS: Wood - 2x4 mill ends, nails, nuts, bolts, screen door spring, eye bolts, or screws.

LEARNING PROCEDURE:

1. The teacher will explain the importance of recycling aluminum.
2. Each class will organize its own corporation with class members as stockholders.
3. A three-man board of directors will be elected by each class.
4. Elect one member as president of the corporation.
5. The board of directors will:
   - handle finances
   - arrange for sale of stocks
   - make policy governing the corporation
   - purchase necessary materials
6. The board of directors will also manage and coordinate activities of the following departments:
   a. Research and development
      - product and design
      - prototype construction
      - final product design

   b. Production tooling
      - break down product into operations
      - design and construct jigs and fixtures to speed production of the product (can crusher)

   c. Production control
      - route product by making an assembly line layout

d. Quality control

  - write specifications which will set quality standards
  - develop systems to check specifications
  - keep records of defect and production adjustments

e. Manufacturing

  - select people for each production job
  - operate the assembly line

f. Marketing

  - establish a price for the "crusher"
  - establish a procedure for advertising and distributing the product (crusher)

7. Have class review the following can crusher production plans.

8. After all departments have done their part to set up the production operation, a trial run is made.

9. Necessary adjustments of equipment, production procedures, and personnel are made.

10. At this point, the distinction between management and labor is clearly defined.

  a. Labor elects business agent to represent workers in dealings with management

  b. Labor and management will negotiate a contract

    (1) May take either of the following courses

      - settlement
      - strike with mediation or arbitration

PRE & POST
TEST QUESTIONS:

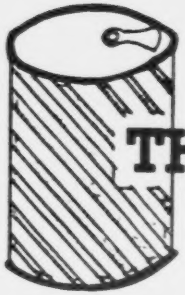
Who might buy the can crusher?

Where could it be sold?

Why should cans be crushed?

How much will a recycler pay for a pound of crushed aluminum cans?

RESOURCES: Projects Unlimited
Grand Island, Nebraska



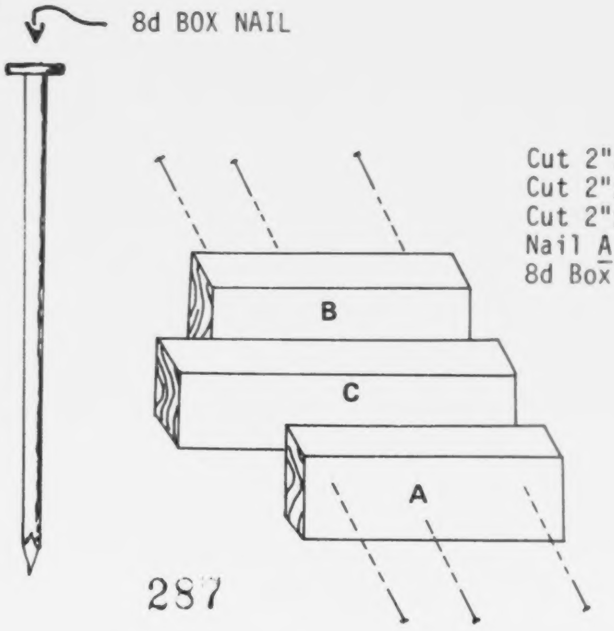
THE CAN CRUSHER

LIST OF MATERIAL NEEDED		PART	ACTUAL SIZE	TOOLS NEEDED
1	2x4x39½"(4')	A	2"x4"x12"	Hand Saw
1	1x4x51" (6')	B	2"x4"x12"	Claw
1	2x2x34" (4')	C	2"x4"x15½"	Hammer
6	8d Box Nails	D	1"x4"x4½"	Square
8	4d Finish Nails	E	1"x4"x15"	Drill
6	¼"x3½" Carriage Bolts	F	1"x4"x15"	¼" Bit
8	¼" Washers (Large)	G	2"x2"x26"	Pliers
10	¼" Nuts	H	2"x2"x7½"	3/8" Open
1	Door Spring	I	1"x4"x6½"	end Wrench
1	Staple (Large)	J	1"x4"x6½"	Scissors
1	Eye Screw	K	1"x4"x3"	Hacksaw

Wood stock should be free of large knots and splits.

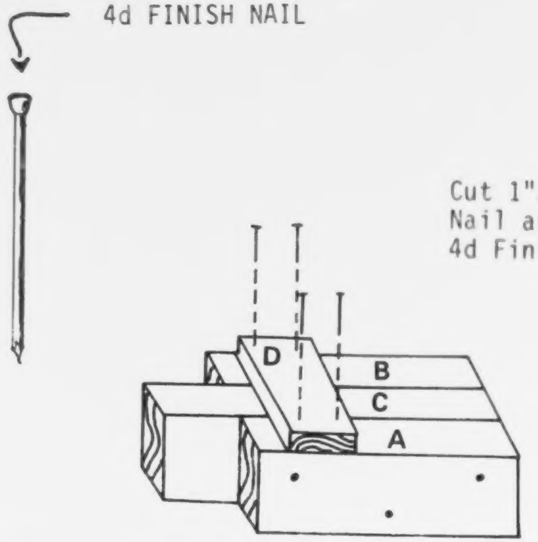
Note: Many of the items may be found at home.

1



Cut 2"x4" A 12" Long
Cut 2"x4" B 12" Long
Cut 2"x4" C 15½" Long
Nail A and B to C with
8d Box Nails

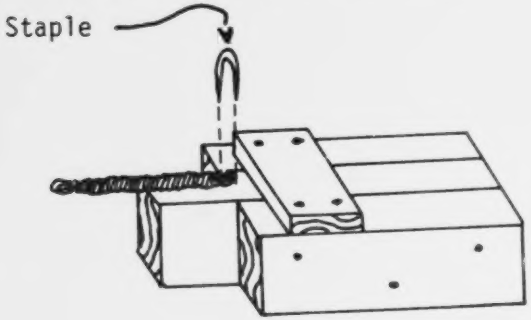
2

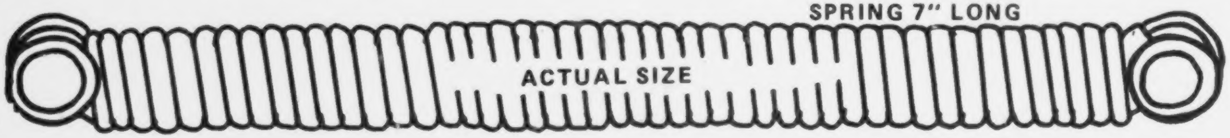


Cut 1"x4" D 4½" Long
Nail as shown using
4d Finish Nails

3

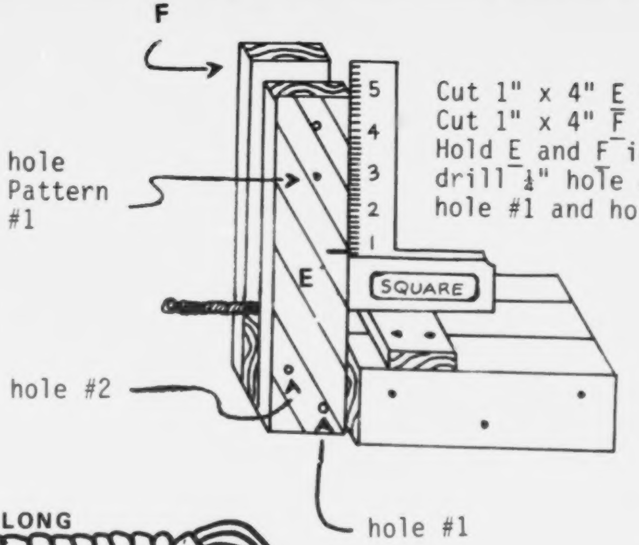
Cut a standard Door Spring 7" long with a Hacksaw or cutting pliers. Bend out two rings of the cut end with pliers so that the spring looks as shown. Staple end to part C as shown.




SPRING 7" LONG
ACTUAL SIZE

4

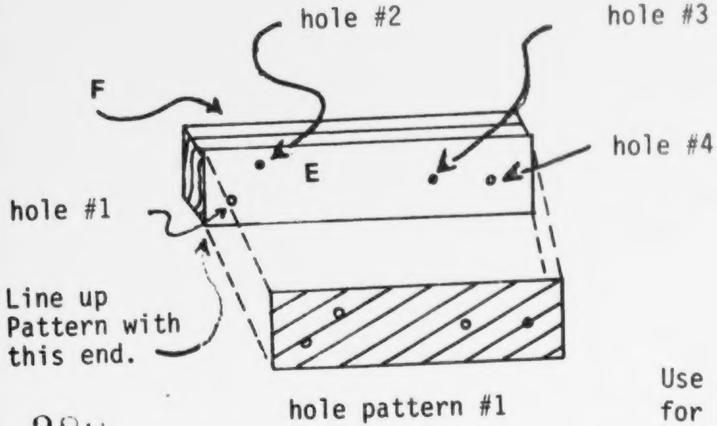
Cut 1" x 4" E 15" long.
Cut 1" x 4" F 15" long.
Hold E and F in place and drill ¼" hole all the way through hole #1 and hole #2


F
hole Pattern #1
SQUARE
E
5
4
3
2
1
hole #2
hole #1

Use pattern #1 other sheet for hole location

5

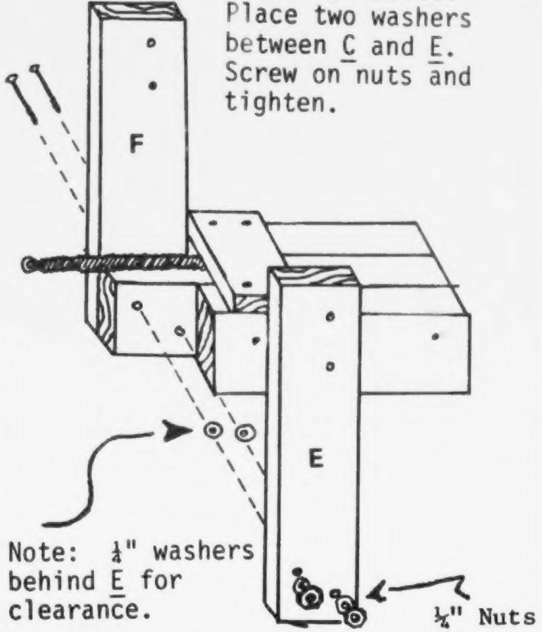
Line up parts E and F.
Drill ¼" hole #3 #4 as shown.


F
hole #2
hole #3
hole #4
E
hole #1
Line up Pattern with this end.
hole pattern #1

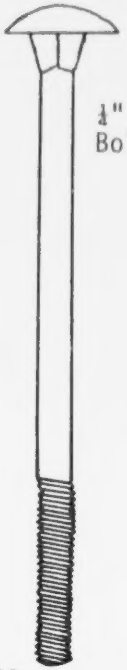
Use pattern #1 for hole location

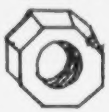
6

Insert ¼" Bolts. Place two washers between C and E. Screw on nuts and tighten.



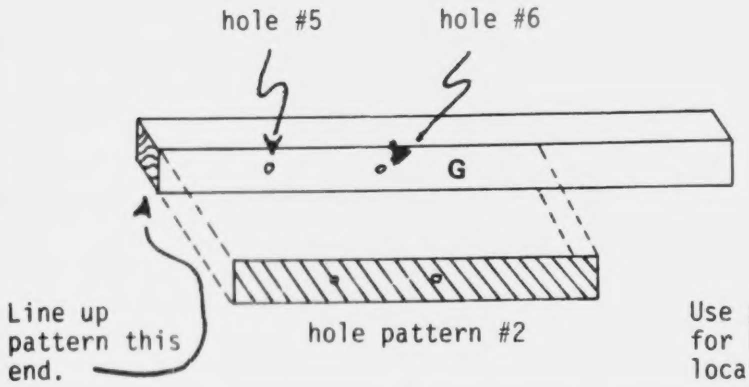
Note: ¼" washers behind E for clearance.


¼" x 3½" Carriage Bolt



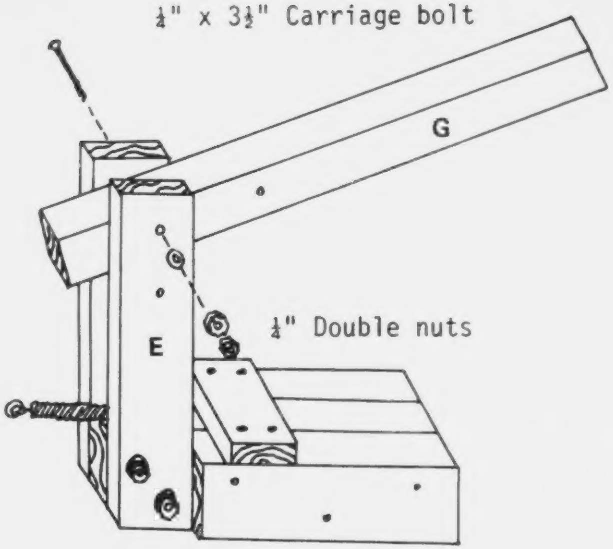
7

Cut 2" x 2" G 26" long.
Drill ¼" hole #5 and ¼" hole #6.


hole #5
hole #6
G
Line up pattern this end.
hole pattern #2

Use pattern #2 for hole location

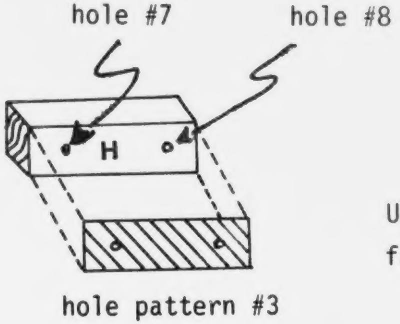
8


¼" x 3½" Carriage bolt
G
E
¼" Double nuts

Place G between E and F as shown. Line up holes #4 and #5. Insert 3½" carriage bolt screw on two ¼" nuts and tighten. G should move up and down freely.

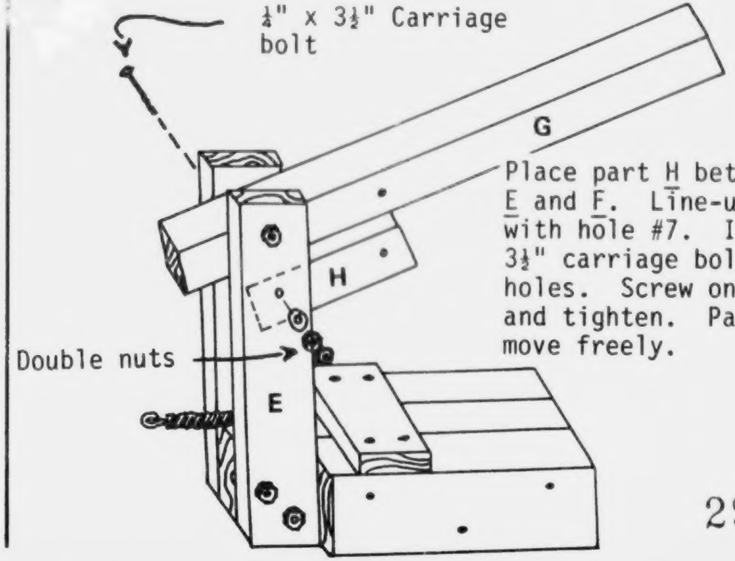
9

Cut 2" x 2" H 7½" long.
Drill hole #7 and #8 as shown.


hole #7
hole #8
H
hole pattern #3

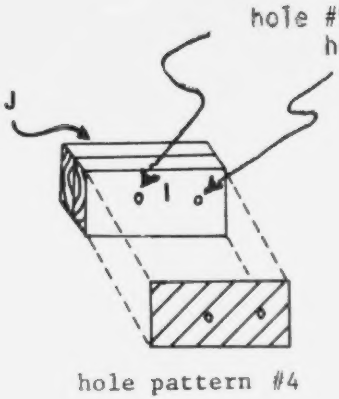
Use pattern #3 for hole location.

10


¼" x 3½" Carriage bolt
G
H
Double nuts
E

Place part H between E and F. Line-up hole #3 with hole #7. Insert ¼" x 3½" carriage bolt through holes. Screw on two ¼" nuts and tighten. Part K should move freely.

11

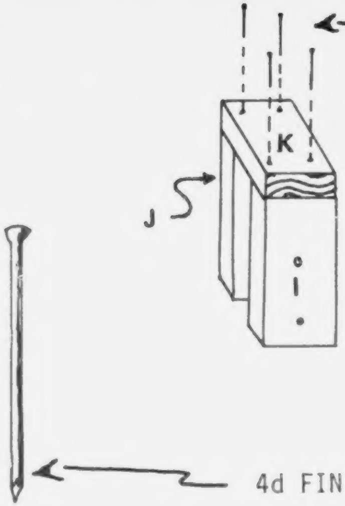


hole pattern #4

Cut 1" x 4" I 6½" long
Cut 1" x 4" J 6½" long
Line up parts I and J.
Drill ¼" holes #9 and #10
as shown

Use pattern #4
for hole location.

12

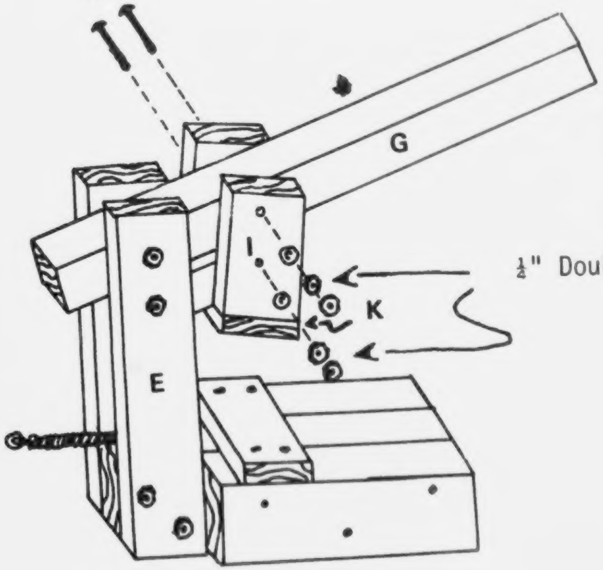


4d Finish Nails

Cut 1" x 4" K 3" long.
Nail K to I and J as shown.
Use 4d Finish nails.

13

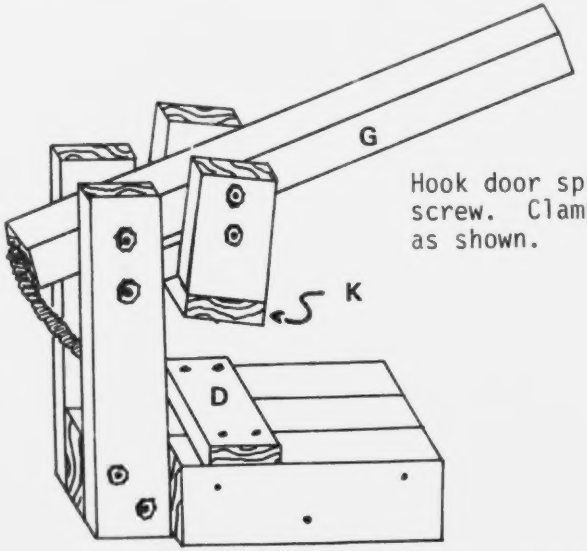
¼" x 3½" Carriage
bolts.



½" Double Nuts

14

Screw eye-screw into end of
part G. Open eye with pliers.



Hook door spring on eye
screw. Clamp with pliers
as shown.

EYE SCREW

IMPORTANT: Plate K and D should meet
squarely in down position.

TITLE: WHERE IT'S AT

USE WITH: Recycling Is Our Business, Is it Yours?, p. 225.

RATIONALE: There are many important groups and individuals that need to be recognized and consulted in the successful operation of a business. Mapping a business district and key business contacts is a valuable tool in the management of a business or project.

SUBJECT: Business

GRADES: 7-10

LEARNING OUTCOME: Students will map the geographic boundaries of a recycling program's "complimentary region" (service area) and include the location of contacts important to the program. They will use this map as an aid in managing a school recycling program or project.

LEARNING PROCEDURE: Students will:

1. Use the data from the feasibility study survey to establish the geographic boundaries of the recycling program's service area. (see School Recycling Program options)
2. Map the boundaries of the program's service area.
3. List contacts important to the recycling program and create a map symbol for each. Some might be:
    a. Individuals and groups willing to contribute financially to the program.
    b. Major contributors of recyclable materials (industries, restaurants, households in community, etc.).
    c. Neighborhood groups that expressed interest in the recycling effort.
    d. Government agencies involved.
    e. Local recyclers (call the WDOE Recycling Hotline, 1-800-RECYCLE, toll free).
    f. Media for publicity.
4. Using the symbols you create, draw a map.

BEST COPY AVAILABLE

5. Use this map to devise "action plans" -- methods to systematically contact contributors, pick up materials, etc.

These materials would then be forwarded to the local recycler.

PRE & POST
TEST QUESTIONS:

Which businesses in your community would be interested in a school recycling program? Why?

Who are the most important people to contact in your community to help your school recycling program?

How will a map with symbols of important contacts help your recycling program?

PEOPLE TO CONTACT
Brown's RECYCLING CENTER

TITLE: A COMPUTER MODEL OF A RECYCLING CENTER

USE WITH: Computer Talk, p. 284.

RATIONALE: A computer can save a business time and money.

SUBJECT: Computer Science, Math

GRADES: 7-12

LEARNING OUTCOME: Students will develop a working model computer program of a recycling center which can be used to make decisions about a school recycling program.

LEARNING PROCEDURE: BACKGROUND:

A recycling center has three suboperations for which computer programs should be developed. These suboperations are: 1) materials management at the recycling site; 2) work schedules during the hours of operation at the recycling site; and 3) the business finances of running the recycling center.

1. Materials Management - This aspect involves: a) the quantity of materials being donated to the school center; b) the size of the containers and the volume/mass they will hold at the school's recycling site; and c) the scheduling of pickup and transportation of materials to the local private recycler.
2. Work Schedules - This aspect involves: a) scheduling individuals to perform the following tasks: breaking glass, cleanup, separating materials, tying and stacking newspapers, closing up the school center, etc.; b) providing a schedule for pickup of recyclables; and c) providing the appropriate number of workers for peak periods.
3. Business Finances - This aspect involves: a) monitoring the income, expenses, and profit of the program; b) distributing the profit to the various organizations involved in running the school center.

PROCEDURE: In order to develop the computer programs:

1. Raw data involving the three aspects mentioned above must be obtained from the individuals operating the school center. Once the data is obtained, the programs should be developed and continually modified to accurately reflect the operation of the recycling center.
2. Daily or weekly entries should be made in the program to keep track of the center's operations.

3. Periodic printouts of the three aspects of the center will be made available to the individuals in charge of running the recycling center. The information provided will enable them to make sound decisions concerning the center's operations.

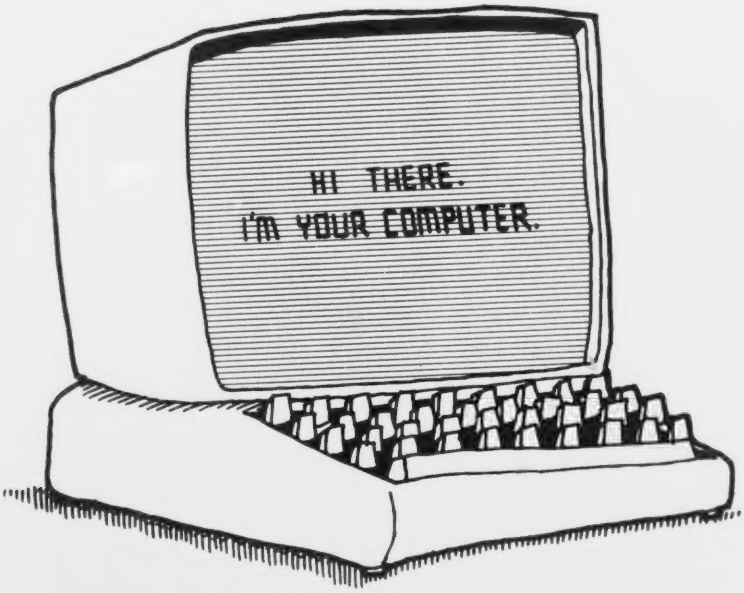
PRE & POST
TEST QUESTIONS:

List three operations involved in a school recycling center which might be efficiently handled by a computer program.

Who could develop and process a computer program for a recycling center in your school?

Once a computer program for a recycling center has been established, estimate the savings in time to operate the center.

How might a computer program save money for a recycling center?


HI THERE.
I'M YOUR COMPUTER.

TITLE: COMPUTER TALK

USE WITH: A Computer Model of a Recycling Center, p. 282, and Wise Use of Paper, p. 201.

RATIONALE: Computer programming is a valuable tool in collating and recording information about resource use in school.

SUBJECT: Computer Programming

GRADES: 7-12

LEARNING Students will create a computer program that is capable of recording and projecting paper use in the school. The program can be modified to include the wood consumed and the energy used in paper production.

LEARNING PROCEDURE:

1. Students may either set up a paper recycling program in the school, or they may collect and record the number of pounds or kilograms of paper products discarded in a given number of weeks.

2. Students may set up a computer program that records and stores information about the amount of paper being collected each week. The program should include: a) the total number of students in the school; b) the average number of pounds or kilograms thrown away per student each week; and c) a running total and average of the above information.

3. The following sample program accomplishes the above tasks. It was written for an Apple computer.

4. By using the following information provided by Scott Paper Company, students may wish to use this program to incorporate other possible calculations such as:

   a. How many trees in the form of paper are being consumed by the school per week?

      In the U.S. South and East Coast regions, an "average" tree used to make pulp for printing and writing paper would probably weigh about 500 pounds. This 500-pound tree, after processing through the paper-making system, would probably make about 100 to 150 pounds of paper.

   b. The amount of energy embodied in the waste paper, being thrown away each week.

      In a typical pulp and paper mill, it would take approximately 27 million BTU's of energy to make a ton of paper. Another way of looking at it would be to say that one gallon of "oil equivalent" would make approximately 11 pounds of paper.

c. The quantity of other resources such as water that it took to produce the discarded paper.

A typical mill would probably use in the range of 25-35 gallons of water to produce a pound of paper.

d. The amount of money that the paper is worth at the recycling center. (Contact the WDOE Recycling Hotline, Toll Free 1-800-RECYCLE for the name and number of the recycling center nearest you.)

PRE & POST TEST QUESTIONS:

Approximately how much paper can be made from an "average" tree?

A typical paper mill will use approximately how much water to produce one pound of paper?

In a paper mill, one gallon of oil-equivalent is required to make approximately how much paper?

ACKNOWLEDGEMENTS:

Special thanks to:

Janet Jones, Consumer Information Center, Scott Paper Company, Scott Plaza, Philadelphia, Pennsylvania 19113.

and Nathan Walters, middle school student at:

Sterling Middle School
Eastmont School District
Wenatchee, WA

Nathan wrote the computer program for this activity.

Sample Computer Program

```
 LIST

10   REM  * RECYCLE *
20   REM  BY NATHAN M WALTERS
30   REM  ON FEBRUARY 20TH 19833
40   REM  ----------------------
50   REM  START PROGRAM
100   TEXT : HOME :D$ =  CHR$ (4)
110   PRINT D$"OPEN WEEK0"
120   PRINT D$"WRITE WEEK0"
130   PRINT "0": PRINT "0": PRINT
      "0"
140   PRINT D$"CLOSE WEEK0"
150   HTAB 18: PRINT "MENU": PRINT

160   PRINT  TAB( 10)"<1> STORE DA
      TA"
170   PRINT  TAB( 10)"<2> RETRIEVE
       DATA"
180   PRINT  TAB( 10)"<3> EXIT PRO
      GRAM"
190   VTAB 20: INPUT A
200   ON A GOTO 240,360,230
210   PRINT "?REENTER"
220   GOTO 190
230   HOME : END
240 D$ =  CHR$ (4): HOME : INPUT
      "POUNDS OF PAPER ?";A
250   INPUT "NUMBER OF STUDENTS ?"
      ;B
260   INPUT "WEEK NUMBER ?";C
270   PRINT D$"OPEN WEEK"C - 1
280   PRINT D$"READ WEEK"C - 1
290   INPUT Y,Z,D
300   PRINT D$"CLOSE WEEK"C - 1
310   PRINT D$"OPEN WEEK"C
320   PRINT D$"WRITE WEEK"C
330   PRINT A: PRINT B: PRINT D +
      A
340   PRINT D$"CLOSE WEEK"C: CLEAR
      : PRINT "DONE"
350   PRINT "HIT ANY KEY TO CONTIN
      UE";: GET PAUSE$: HOME : GOTO
      150
360   HOME :D$ = CHR$ (4)
370   INPUT "WEEK NUMBER ? ";A: PRINT

380   PRINT D$"OPEN WEEK"A
390   PRINT D$"READ WEEK"A
400   INPUT B,C,D
410   PRINT D$"CLOSE WEEK"A
420   HOME : PRINT "WEEK:"A: PRINT

430   PRINT "POUNDS OF PAPER:"B
440   PRINT "NUMBER OF STUDENTS:"C

450   PRINT "AVE. NO. OF LBS PER S
      TUDENT:"B / C
460   PRINT "KILOGRAMS OF PAPER:"B
       / 2.2
470   PRINT "AVE.NO. OF KILOS PER
      STUDENT:";:Z = B / C: PRINT
      Z / 2.2
480   PRINT
490   PRINT "TOTAL NO. OF POUNDS:"
      D
500   PRINT "TOTAL STUDENT AVE."D /
      C
510   PRINT : PRINT "HIT ANY KEY T
      O CONTINUE";: GET PAUSE$
520   HOME : CLEAR : GOTO 150


/*END
```

TITLE: PUBLICIZING THE RECYCLING CENTER

USE WITH: Speak Up For Recycling, p. 268, and Take-Home Recycling Kit, p. 229.

RATIONALE: The development of a coordinated publicity campaign will encourage people to participate in a recycling program.

SUBJECT: Art

GRADES: 7-12

LEARNING OUTCOME: Students will develop a strategy and materials to publicize the location, operating procedures, and hours of a recycling center.

LEARNING PROCEDURE:

1. Determine the information to be presented in the advertising.
   a. The content should tell people why we need to recycle. These reasons might include: reduce family wastes and household disposal costs, conserve natural resources, save energy, reduce the size and number of landfills.
   b. The content should tell individuals how to recycle: How to prepare glass, tin, aluminum cans, newspaper, other papers, bottles, oil and so on for recycling. (See the activity "Take-Home Recycling Kit" p. 229.)
   c. The content should tell people where the nearest recycling center is and its hours. (Call the WDOE recycling hotline for the location of the recycling center nearest you: 1-800-RECYCLE)
2. Taking into account the potential audience and placement of publicity, design and produce the media (posters, flyers, bulletin boards, news releases, etc.).
3. Distribute the publicity materials.

   The materials should have wide distribution and should reach organizations, individuals, and families most likely to participate in the recycling program.
4. Evaluate the publicity materials.

   An ongoing evaluation should be made of the publicity materials to ensure that they are accomplishing the objective of reaching contributors with current information.

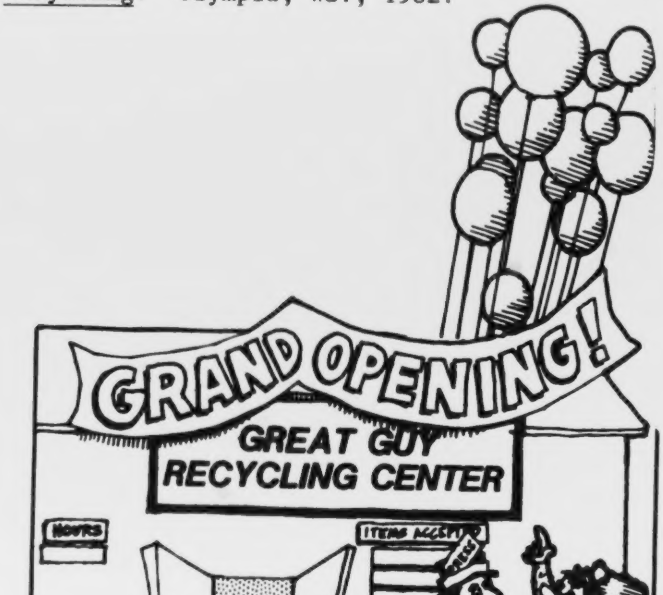
PRE & POST
TEST QUESTIONS:

Name five potential contributors to a recycling program.

What four reasons might a family have for contributing to a recycling program?

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. Guide to Household Recycling. Olympia, Wa., 1982.


GRAND OPENING!
GREAT GUY RECYCLING CENTER
HOURS
ITEMS ACCEPTED
PRESS
23
MISS RECYCLING

TITLE: WHEN CAN YOU WORK?

USE WITH: A Computer Model of a Recycling Center, p. 282.

RATIONALE: For efficient operation, student-managed recycling centers need well-planned work schedules.

SUBJECT: Business

GRADES: 8-11

LEARNING OUTCOME: Students will be able to solve the scheduling problem for a weekend recycling center. (See School Recycling Program Options.)

LEARNING PROCEDURE:

1. Read with students the following problem situation:

   The Science Club started a recycling center at an old building in the center of town. Use of the building was donated by a local merchant. Members of the club will donate their time over the weekend.

   The center will be open from 4:00 p.m. - 8:00 p.m. Friday and from 8:00 a.m. - 8:00 p.m. on Saturday and Sunday. Two student workers need to be at the center at all times. Each student will work for four hours.

   There are 17 members of the Science Club, but Mary has been ill and can't work. Jim and Jeff can't work Friday or Saturday after 6:00 p.m. because of a basketball game. Megan wants to work with Shelly so they can carpool. Becky and Brian are going on a trip Sunday. Bill, Jean, and Bob won't be available until Sunday at noon. Eric and Sara can't work Friday or Saturday.

2. Make a schedule for the 17 members arranging the shifts so each student works only four hours when he or she is available. Two members are to be scheduled for standby.

   Mary
   Sara
   Brian
   Kevin
   Jeff
   Jean
   Megan
   Andrea
   Bill
   Mark
   Eric
   Frank
   Becky
   Bob
   Jim
   Shelly
   Pat

EXTENDED LEARNING: Draw posters giving the operating hours and showing the location of the recycling center.

PRE & POST TEST QUESTIONS:

What factors are important to consider when designing a work schedule for a business?

How could the workload be shared equally?

Who should be responsible for scheduling the workload hours?

TITLE:	RED OR BLACK?
USE WITH:	The Goodness of Your Heart vs. The Bottom Line, p. 244, and Recycling is Our Business, Is It Yours?, p. 225.
RATIONALE:	Net profit and net loss concepts and calculation methods must be understood for the successful operation of a business.
SUBJECTS:	Business, Math
GRADES:	5-9
LEARNING OUTCOME:	Students will determine the total income and total expenses of a school recycling center for one month.
LEARNING PROCEDURE:	

1. Problem. The school recycling center collected 5½ tons of newspaper during the month of January and received $35/ton. A half ton of cardboard was collected at $25/ton. Sixty-five pounds of aluminum cans were collected at .25/lb. Glass was also separated and collected. The clear glass sold for .02/lb., and the center received 115 pounds. The green glass sold for .03/lb., and they received 18 pounds. Brown glass sold for .01/lb., and the center received 26 pounds.

   Calculate: Total Income

   Method: Multiply the number of pounds by the price per pound for each item and then add these for the total.

Add:	Newspaper	$192.50
	Cardboard	12.50
	Aluminum	16.25
	Glass-	
	clear	2.30
	green	.54
	brown	.26
Total:		$224.35

   (Note: In March, 1983, according to figures from Ideal Paper Company, a Seattle recycling company, all three colors of glass were selling for .01/lb.)

2. Problem: In January, the recycling center also had several expenses. A new lock was needed for the paper bin at $7.95. Transportation costs amounted to 8 round trips at 16 miles/trip. The center pays the owner of the car .22/mile.

   The recycling center also printed 500 flyers at a cost of $13.50 per each group of 100.

   Calculate: Total expenses for January.

Method: Multiply the number of trips by the amount paid per mile. Multiply the cost per each group of 100 flyers by the number of groups. Add these two numbers.

Add:	Lock	$ 7.95
	Transportation	28.16
	Flyers	67.50
Total:		$103.61

The NET (profit or loss) is the DIFFERENCE between the TOTAL INCOME and TOTAL OUTPUT.

If the income is larger, the difference is called the NET PROFIT. If output is larger, it is called the NET LOSS. The net profit is written in black, indicating that the finances are in order. The net loss is written in red, indicating the failure of the business to meet its expenses.

3. Calculate: The net profit or loss for the recycling center in January.

Method:	Income	$224.35
	Output	103.61
NET PROFIT:		$120.74

EXTENDED LEARNING: Assuming an income of $120.74 monthly for an entire year, at a given interest rate (check out interest rates at local savings, banks, etc.), figure the annual income for the recycling center.

PRE & POST TEST QUESTIONS:

What is the difference between gross profit and net profit?

How could you determine the net profit or loss for one year?

If the business failed to show a profit, what could be done to improve the situation?

BIBLIOGRAPHY: Weaver, et al. Accounting 10-12 3rd Ed. Gregg Publishers, 1968.

Swanson, et al. Century 21 Accounting 3rd Ed., Southwest Publishing Co.

TITLE: YOU CAN GET THERE FROM HERE

USE WITH: The Goodness of Your Heart vs. the Bottom Line, p. 244.

RATIONALE: Two factors that help determine the feasibility of a business are:

1. Transportation costs of the materials or product.
2. The value of the materials being transported.

SUBJECT: Geography

GRADES: 9, 10

LEARNING OUTCOME: Students will determine if establishing a recycling center is a financially sound decision by gathering and analyzing the cost to transport recyclable materials and comparing these costs with the actual value of the recyclables. Students will understand that ". . . if somewhere along the line recycling doesn't pay enough, it won't be done, at least not for long."[1]

LEARNING PROCEDURE: Students will:

1. Create a set of map symbols that communicate the type and value of materials a recycler handles.
2. Map the location of recyclers and the school recycling center.
3. Identify and map the transportation routes from the recycling center to the various recyclers.
4. Develop a set of symbols for transportation routes which will graphically communicate the cost and efficiency of transportation (i.e., four routes in red, blue, green, and yellow).

   Determine:

   a. Shortest, least costly route to recycling center
   b. Mileage to and from recycling center
   c. Vehicle costs; maintenance, insurance, etc.
   d. Difference between income from recyclables and cost of transportation
5. Combine all of the information in Steps 1-4 into one map in a way that clearly displays each set of information.

6. Have students now compare the transportation costs with the value of the material being transported. Contact WDOE Recycling HOTLINE (1-800-RECYCLE) and local recyclers to obtain this information. Possible questions to consider:

   a. Should the recycling center exist at all?
   b. Should the recycling center be located elsewhere?
   c. Is the transportation system cost-effective?
   d. Are there better transportation routes?
   e. Would a larger vehicle help to increase profits?
   f. Could some group donate the use of a vehicle?
   g. What are other considerations besides transportation costs that determine the effectiveness of a program?
   h. Would the recycler pick up the materials?
   i. What if the price for materials decreases?
   j. Should material be recycled at a loss?

EXTENDED LEARNING: Investigate what other market factors, besides transportation costs, influence the feasibility of a recycling business.

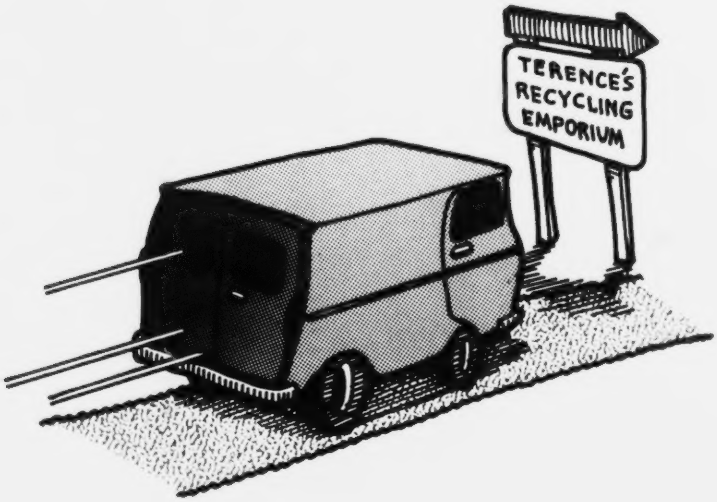
PRE & POST TEST QUESTIONS:

What reasons might a school have for a recycling program besides the profit motive?

How much does it cost per mile to drive your vehicle? (include repairs, maintenance and insurance)

How could an increase in price of gasoline affect profit or loss of a school recycling center?

SOURCE: [1]White, Peter T. "The Fascinating World of Trash." National Geographic, April, 1985, Vol. 163, No. 4, p. 450.



TITLE: ACCOUNTING FOR RECYCLING

RATIONALE: A basic understanding of the processes of a specific business is necessary before a record keeping system can be chosen for that business.

SUBJECT: Accounting

GRADES: 11, 12

LEARNING OUTCOME: Students will be able to recommend the necessary accounting books and procedures for a recycling center at the school.

MATERIALS: Accounting texts with illustrations of income statements and balance sheets. (See references below)

LEARNING PROCEDURE:

1. Outline how a school recycling center operates.
2. On the board, illustrate an example of an estimated balance sheet showing assets, liabilities, and net worth.
3. Illustrate on the board an example of an estimated year's end income statement that shows net income (or loss) for the expense accounts that would apply to the school recycling operation.
4. Estimate the cash requirements for the recycling program's first period of operation. An understanding of both fixed and variable costs would be involved.
5. Evaluate the above examples and choose a reasonable system of journals, ledgers, and petty cash books which could be easily kept, yet which would adequately reflect the business operations of the recycling center.
6. Recommend cash control methods for the protection of cash involved in the recycling operation.

PRE & POST TEST QUESTIONS:

Estimate the cash requirements for your recycling center for one year.

What is the minimum number of bookkeeping systems necessary for the successful operation of a recycling center?

Could a computer program be designed to account for the recycling center?

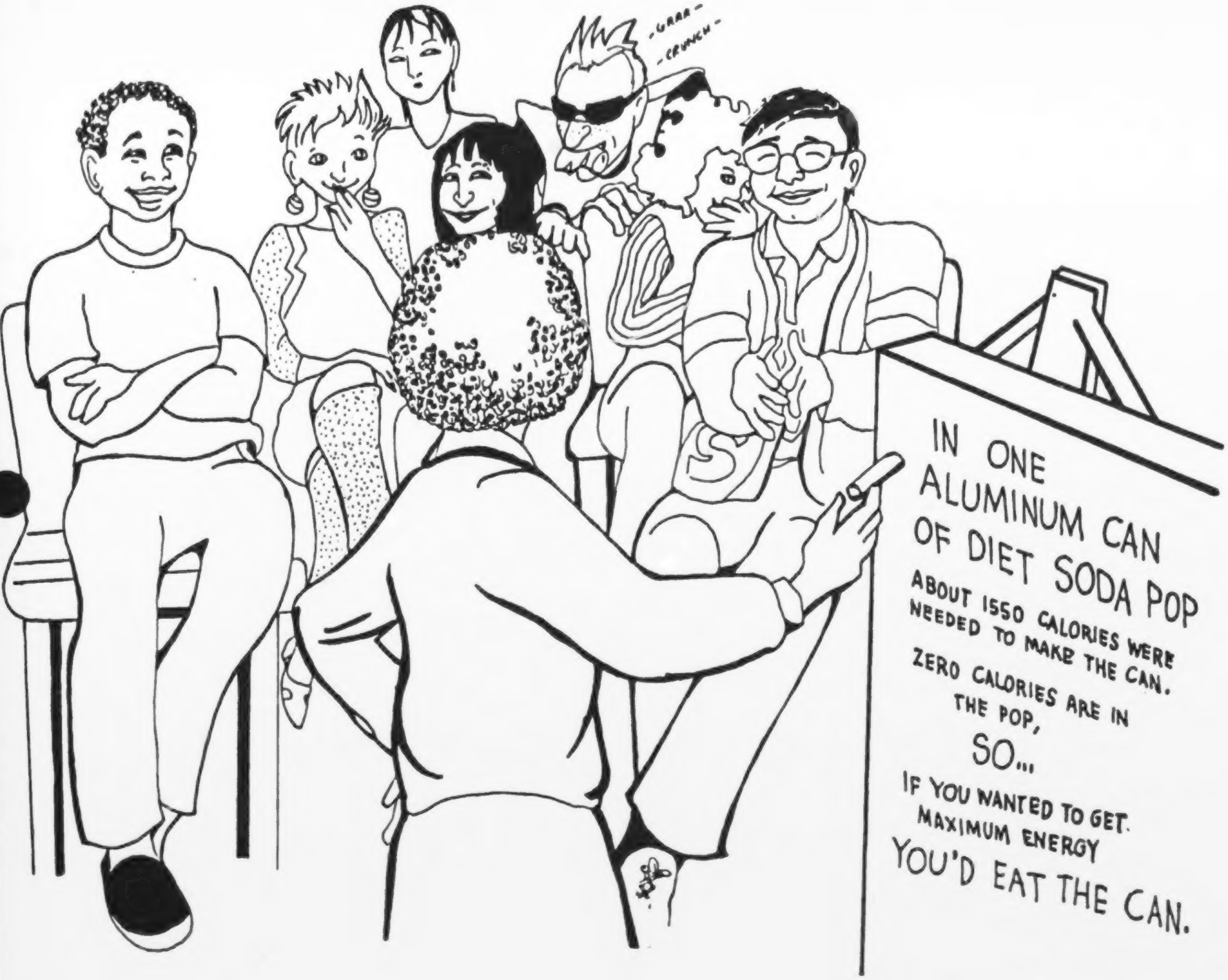
What is cash control?

BIBLIOGRAPHY: Weaver, et al. Accounting 10-12, 3d ed., Gregg Publishers, 1968.

Swanson, et al. Century 21 Accounting, 3d ed., Southwest Publishing Co.

RECYCLE!
GO RECYCLE!
HOW TO GO RECYCLE!
GO RECYCLE!

RECOVER


-GRRR-
-CRUNCH-
IN ONE ALUMINUM CAN OF DIET SODA POP
ABOUT 1550 CALORIES WERE NEEDED TO MAKE THE CAN.
ZERO CALORIES ARE IN THE POP,
SO...
IF YOU WANTED TO GET MAXIMUM ENERGY
YOU'D EAT THE CAN.

TITLE:	THE ROAD TO RECOVERY
USE WITH:	Deciding Where It's Going to Go, p. 142.
RATIONALE:	In the near future, energy recovery facilities, also known as resource recovery facilities or waste to energy plants, will play an increasingly important role in managing America's solid waste.
SUBJECTS:	Social Studies, Civics, Government
GRADES:	9-12
LEARNING OUTCOME:	Students will learn what resource recovery plants are and basically how they operate. Students will consider the good and bad aspects of resource recovery as a solid waste management option.

LEARNING PROCEDURE:

1. Ask: What happens to the garbage your families produce?

   Ask: How many of your families set all your garbage out to be collected? Where is it taken? What is a landfill? What happens to the garbage after it is dumped and covered in a landfill? How much does it cost to have your garbage collected? What are the good and bad aspects of sending your family's garbage to the landfill?

   Ask: Who recycles? What does recycling mean? Why does your family recycle? How does your family actually go about recycling? Where does your family take the recyclables? What things are easy to recycle? What things are difficult? What's good about recycling? What's bad? One method of recycling is to reuse things or to give them to someone who needs them. How many of your families, for example, donate to charitable organizations?

   Ask: How many families of people in this class have a compost pile? What is composting? How do you do it? Why is it a good thing to do? What are the benefits of composting? What are the drawbacks?

2. Ask: In what other ways might we take care of our garbage and other solid waste? List responses.

3. Show students the following overhead illustrating the basic operation of a resource recovery facility.

TEACHER BACKGROUND: Resource recovery facilities, also known as energy recovery facilities or waste to energy plants, are an expensive, highly technological method of dealing with large volumes of solid waste. The basic operating principles of these energy recovery plants are either to burn refuse ("mass burning") without any attempt to separate recyclables or separate recyclables by mechanical means either before ("front-end processing") or after burning. In any case, 20 to 30 percent of the original refuse is noncombustible and nonrecyclable and must be disposed of in a landfill. Intense heat from burning "refuse derived fuel" or "rdf" creates steam which, in turn, may be used to generate salable electricity. Other resource recovery facilities have been designed that produce industrial gas or fuel. Solid waste managers hope that a continuing rise in the cost of electricity will help pay off the cost of energy recovery plant construction. Given the enormous volumes of solid waste produced in urban areas, many solid waste managers have come to see energy recovery facilities as necessary components, along with landfills and recycling, of solid waste management systems.

Critics of energy recovery plants, however, raise objections. Some of these are the high cost of construction and the air pollution caused by refuse burning. Critics also point out that energy recovery plants require a steady high-volume flow of garbage. Maintaining that flow, critics say, will discourage recycling and will allow people to avoid their individual responsibility to generate less waste. Some recyclers also raise the specter of "flow-control" -- local governments strictly regulating the ownership and disposition of solid waste in an attempt to ensure a steady stream of fuel for the refuse burners.

The City of Seattle is currently considering the construction of an energy recovery facility. Facility planners are taking into account a projected Seattle output of 1500 and 2000 tons of solid waste a day. Planners estimate that between 50 and 70 megawatts of electricity per year could be supplied to Seattle City Light by an energy recovery facility, and that the facilities (if several smaller plants were built), or the facility would cost from $150 million to $500 million.

For further information read the following Seattle Times/ P.I. article entitled "Garbage: A Burning Issue."

3. Have students read the following article reprinted from the Sunday Seattle Times/P.I. "Garbage: A Burning Issue."

Projecting an overhead or using copies of the energy recovery facility diagram, explain the plant's basic operation.

Ask: Why would Seattle need such a facility? How much do you think such a plant would cost? What effect would the operation of such a plant have on the way individuals handled their garbage? What effect would such a facility have on recycling? What are advantages of this method of solid waste management? What are the drawbacks? Who would pay for the construction and operation of such a facility? How would it be paid for? Would you favor or oppose the construction of an energy recovery plant to burn Seattle's solid waste?

4. Discuss: "Herein lies a hard learned truth: whatever the treasure in trash, it isn't the materials or the energy one might get out of it -- it's mainly what one can collect for just getting rid of the stuff."[1]

5. Consider the following solid waste management options: Landfills/energy recovery; facilities/recycling; and composting/reduced and selective buying which would reduce waste.

   Ask: Which one of these options is the best long-term choice? Why? Which option could most people participate in? Is any of these options adequate on its own to handle your community's solid waste? If you were the city official with responsibility for dealing with solid waste, which would you choose? Who in your local government makes decisions about the management of solid waste?

6. Examine the following diagrams outlining two possible systems for dealing with the City of Seattle's solid waste.

   Referring to Diagram 2, ask: Without a resource recovery facility, does 65 to 70 percent of Seattle's solid waste have to end up at the landfill? What could people do to reduce that amount of waste?

7. Organize a debate around the following proposition: our city/county should build a mass burner to incinerate our garbage. Call solid waste managers, recyclers, spokesmen for environmental groups, and burn plant construction company representatives for points of view on this subject.

PRE & POST
TEST QUESTIONS:

Where is the garbage produced by your family finally disposed of?

How do energy recovery facilities process solid waste?

What are the advantages of an energy recovery facility as a means of dealing with solid waste? What are the disadvantages?

SOURCE: [1]White, Peter T. "The Fascinating World of Trash." National Geographic. April, 1983, Vol. 163, No. 4, pp. 424-457.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

"Waste to Energy," California Solid Waste Management Board, filmstrip/cassette, 10 min., color.

ACKNOWLEDGEMENTS:

Special thanks to Conrad Lee, City of Seattle, Solid Waste Utility for help with this activity. Diagrams 2 and 3 are by Conrad Lee.

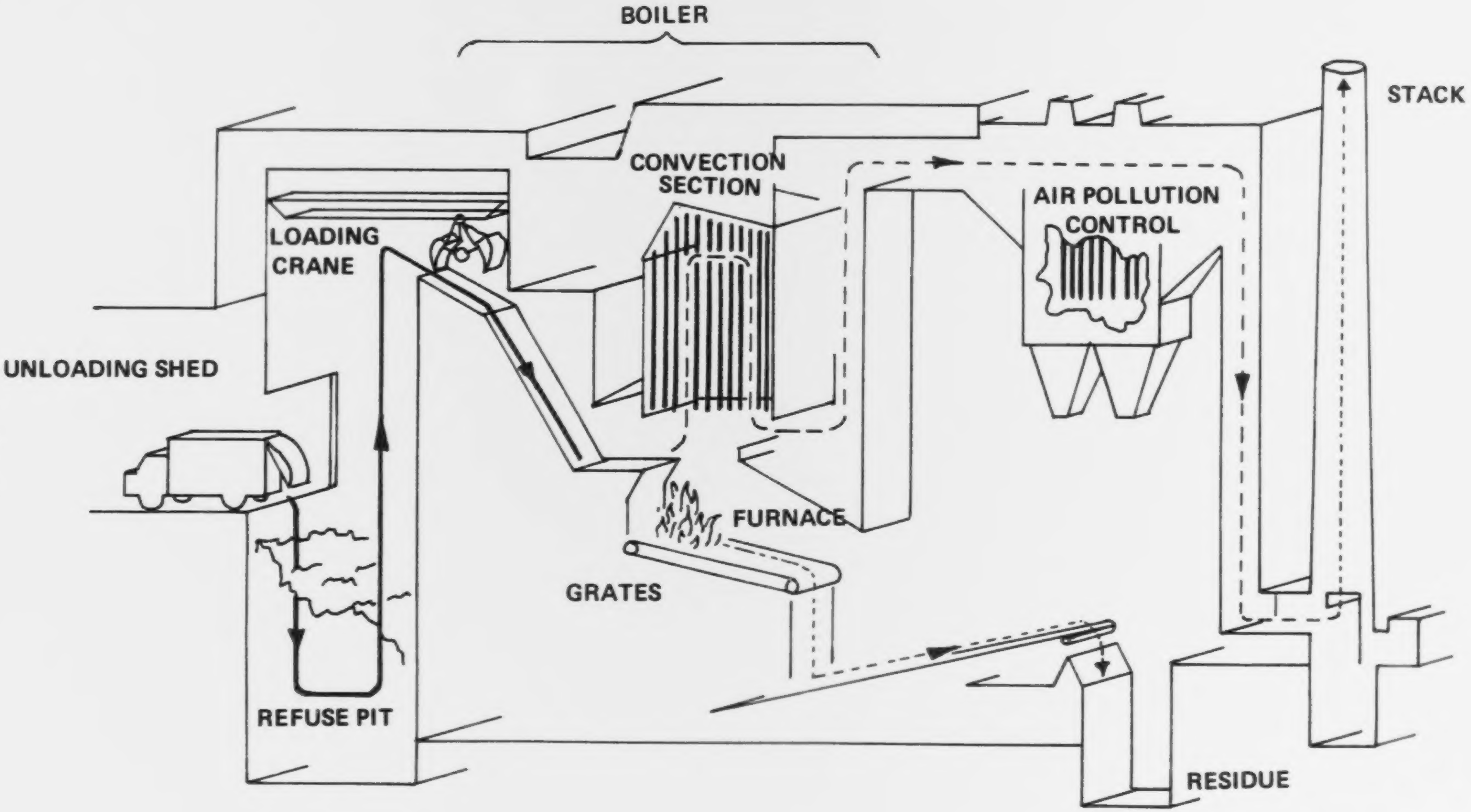
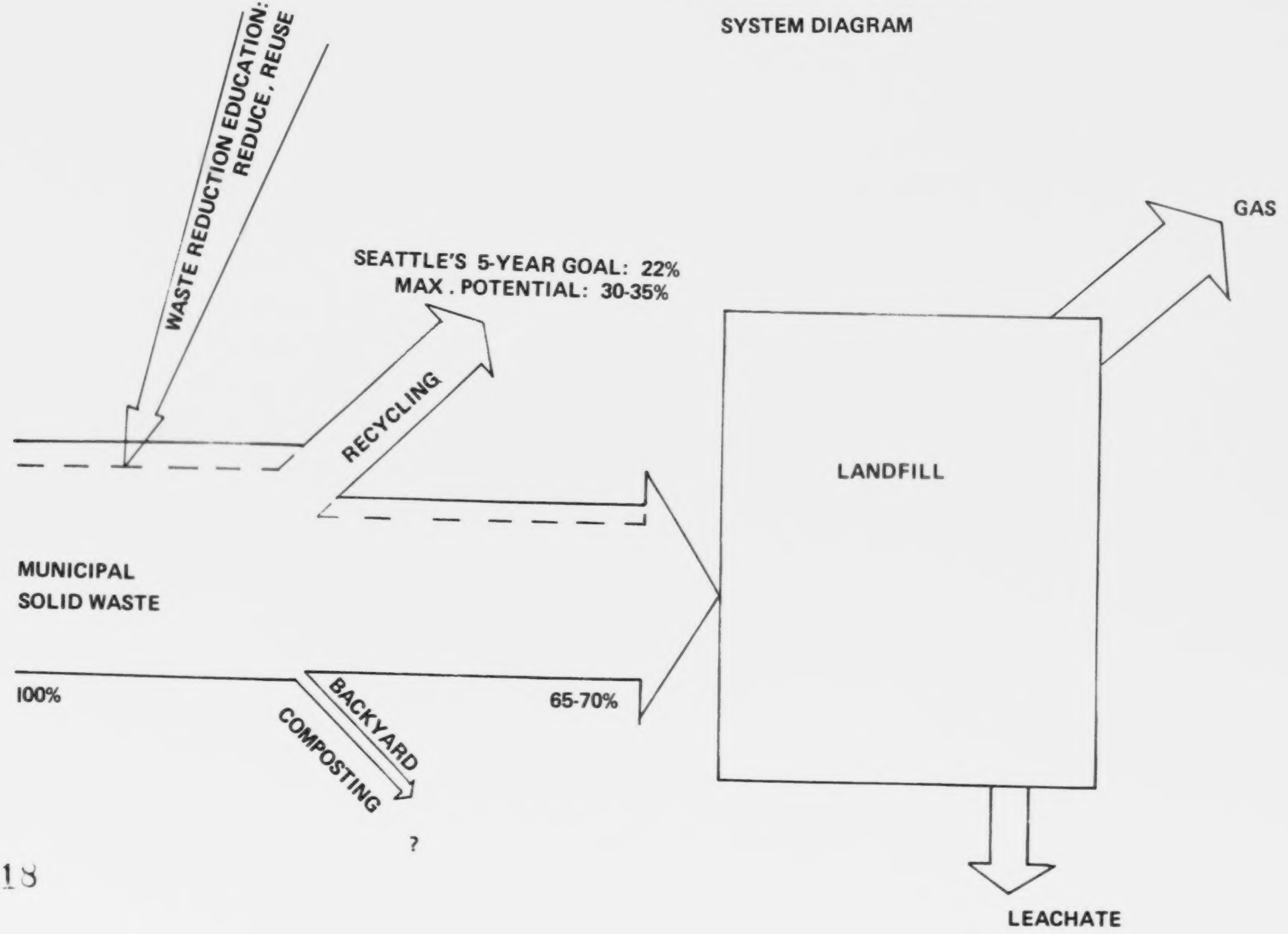
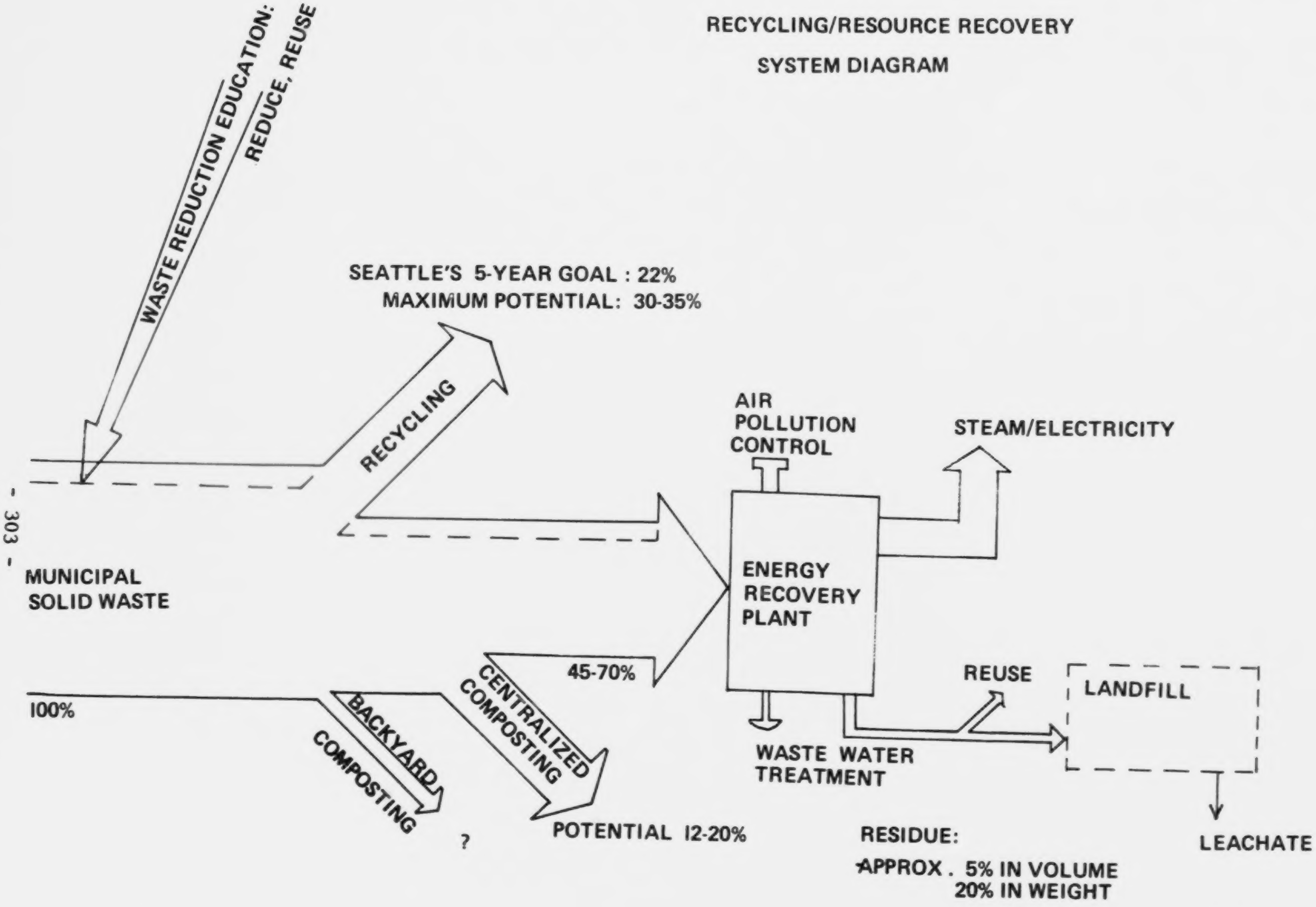

BOILER
STACK
CONVECTION SECTION
AIR POLLUTION CONTROL
LOADING CRANE
UNLOADING SHED
FURNACE
GRATES
REFUSE PIT
RESIDUE

Figure I. Typical Waterwall Furnace for Unprocessed Solid Waste

RECYCLING/WASTE REDUCTION SYSTEM DIAGRAM


WASTE REDUCTION EDUCATION:
REDUCE, REUSE
SEATTLE'S 5-YEAR GOAL: 22%
MAX . POTENTIAL: 30-35%
RECYCLING
GAS
LANDFILL
MUNICIPAL
SOLID WASTE
100%
BACKYARD
COMPOSTING
?
65-70%
LEACHATE

RECYCLING/RESOURCE RECOVERY SYSTEM DIAGRAM


WASTE REDUCTION EDUCATION:
REDUCE, REUSE
SEATTLE'S 5-YEAR GOAL : 22%
MAXIMUM POTENTIAL: 30-35%
RECYCLING
AIR
POLLUTION
CONTROL
STEAM/ELECTRICITY
MUNICIPAL
SOLID WASTE
ENERGY
RECOVERY
PLANT
45-70%
REUSE
LANDFILL
100%
BACKYARD
COMPOSTING
CENTRALIZED
COMPOSTING
WASTE WATER
TREATMENT
?
POTENTIAL 12-20%
RESIDUE:
APPROX . 5% IN VOLUME
20% IN WEIGHT
LEACHATE

GARBAGE : A Burning Issue

Bill Dietrich, Times Staff Reporter

Cedar Hills - The ridge is a half mile long, a quarter mile wide and up to 425 feet high. From a distance, thanks to a thin layer of dirt, it looks like a glacial moraine. But grinding bulldozers and a cloud of seagulls give clue to this landscape's true composition: garbage.

It is a man-made mountain of trash, growing by 2,600 tons per day.

This is King County's Cedar Hills landfill, tucked away in the trees between Issaquah and Maple Valley. Biggest in the state, it represents the traditional answer to an age-old problem in our throwaway society. Annually we each average more than a ton of household and industrial waste - enough from Seattle alone to fill the Kingdome three times.

We are up to our ears in rubbish, running out of landfill room, plagued by ground water pollution and scrambling for a better idea.

Now Seattle, Tacoma, Everett, Bellingham, and Spokane simultaneously think they've found one. Copying more than 50 other American cities, they want to burn solid waste for energy.

The cost is staggering. Seattle's proposed trash-burning plant is estimated to cost about $200 million, exceeding the high-level West Seattle Bridge as the most expensive project in city history.

Statewide, the number is even more numbing. The state Department of Ecology (DOE) has $90 million in Referendum 39 bonds approved by the voters in 1980, to serve as 50 percent matching grants for local communities wanting to improve solid waste disposal. DOE recently asked Washington's communities for their wish list of garbage-disposal proposals, the six-year price tag: $900 million.

For the first time, however, burning garbage appears to be almost as cheap as burying it. Using waste for fuel could generate a total of 90 to 100 megawatts of electricity in the five Washington cities most seriously considering it. Seattle, accounting for half of the 90 megawatts, could light 25,000 homes and earn $85,000 to $110,000 per day. By contrast a nuclear plant generates about 1,000 megawatts.

"Landfills are a dead-end-road," said Dennis Hein, Spokane solid waste manager. "You pour money into them and get nothing back."

In fact, a garbage-to-energy plant has enough potential for profit that private enterprise might be enticed to build and operate one. Seattle has forecast a profit margin of 30 percent if City Light agrees to buy the energy at 5.2 cents per kilowatt hour, compared to a cost of 7 to 10 cents for nuclear energy. A private company taking advantage of 1983 tax and investment laws could build a plant, run it at a profit and still charge less than a publicly owned facility, according to David Birks, project manager for Seattle's burning plant.

The ash that remains after incineration would still have to be buried, but it would have only a tenth of the volume and 30 percent of the weight of the original garbage. That would postpone the need to find new landfills, an acrimonious process that DOE now estimates averages six years and $1 million in legal fees and staff time for each site.

And it would allow urban residents to take care of their garbage problems in their own city, instead of unloading the mess onto their rural neighbors.

"Why bury all those BTUs?" asked Larry Wright of Yakima, an assistant director of that city's community and economic development department. He is exploring trash-burning to generate steam for Yakima food processors and other industries.

Why indeed? The U.S. Conference of Mayors estimates one-eighth of the garbage Americans throw away is or shortly will be burned for energy-58,000 tons per day.

An October 1983 conference survey found there were 52 waste-to-energy plants operating, five in shakedown phase, 11 under construction and 22 nearing construction. Another 90 were being planned. Europe has 300 such plants, and Japan already burns two-thirds of its trash.

But Seattle's proposed furnaces attracted plenty of heat recently in a series of neighborhood meetings, drawing "any-place-but-here!" outrage from two of the three neighborhoods suggested as sites.

The sites are the Duwamish substation near South Park just outside the southern city limits; East Marginal Way south of South Spokane Street below Beacon Hill, and the Fremont area on the north side of Lake Washington Ship Canal, between the Fremont and Ballard bridges. Only the Fremont crowd was cautiously receptive.

"Everybody generates garbage, but nobody wants a site near them," noted Avery Wells, solid waste director for DOE. "I've often wondered if I'd want one near me."

The effect of a waste-to-energy plant on recycling, air pollution, noise, truck traffic, and garbage fees will be scrutinized if the City Council approves an environmental impact study later this spring.

There is another concern, waste-to-energy technology, only about a decade old in this country, has had its share of failures and bugs. Just six plants the size of Seattle's proposal are operating successfully. Two more are shut down, one for financial reasons and the other to set air pollution limits. Several more are under construction.

Still, said Wells, "Seattle has been talking about this for years, and I'm finally convinced something is going to happen:

Some of the plans:

- Seattle had to close its Midway landfill last October because of ground water pollution problems and lack of room, and will use up its last landfill, on a hillside above Kent, by 1986. That means it will have to start trucking garbage to King County's Cedar Hills.

The city hopes to decide by 1985 on a site or sites within the city for a 2,000-ton-per-day plant. That would be big enough to burn the 1,600 tons a day the city collects (but not to burn the 600 tons of commercial waste privately collected and already trucked to Cedar Hills). A plant at that site would cost from $186 million to $205 million, planners guess could be privately built and run, and could be completed by 1990.

- King County has estimated a life span for Cedar Hills of up to 30 years if lawsuits don't curtail operations there. But that means allowing the garbage ridge to grow 1,000 feet high. So, while the county is less pressured for time than Seattle, Rod Hansen, manager of solid-waste-disposal operations, said a waste-to-energy plant might make sense for the county, too. It is studying whether a combined facility handling both city and county garbage makes more sense.
- Tacoma spent $2.5 million in 1977 to build a plant to convert garbage into fuel pellets for commercial furnaces. That project turned into a fiasco when customers for the fuel never materialized. Now the city is considering spending $20 million to convert the fuel plant to an energy plant consuming up to 400 tons of trash per day and generating seven megawatts for Tacoma City Light.

- Snohomish County wants to spend $60 million to $90 million for a 500-ton-per-day trash burning plant on Smith Island in Everett's industrial area. It would generate 12.5 megawatts.
- Bellingham and Whatcom County are considering replacing that city's existing garbage incinerator, built in 1974, with a waste-to-energy plant consuming 150 to 200 tons per day. It would cost $7 million to $10 million, and generate either steam or up to 2.5 megawatts of electricity.
- Spokane has blueprints for a $100 million waste-to-energy plant burning 650 tons of garbage a day and generating 17 megawatts of electricity or seven megawatts plus steam.

Most other large Washington cities have at least considered the technology. In the Port Angeles area, officials are discussing whether to burn garbage along with woodwaste. In Yakima, the city is exploring the feasibility of generating power and steam for local food processing industries.

The reason for all this interest can be read in nightly headlines. For example: the "black lagoon" of leached garbage waste at the closed Midway landfill; the underground fire that is still burning at the Go-East dump in Snohomish County; the expensive pipes and plastic to catch leachate at Cedar Hills before it pollutes salmon streams, and the public opposition to new landfills.

Plus, "Economics are at the break-even point," said Wells. "It's now as cheap to build a resource recovery plant as a new landfill."

Power rates have risen, making the generated electricity more valuable and future landfills - if they can be found at all - will have to be quite elaborate to meet environmental restrictions.

For example, it costs commercial haulers who dump trash at Cedar Hills landfill just $11 per ton, while the net fee at a new Seattle trash-burning plant is roughly estimated at $35 to $52 per ton. But at Snohomish County's Cathcart landfill, a state-of-the-art operation lined with plastic to collect leaking waste and prevent ground water contamination, dumping costs are $35 per ton now and the price is expected to climb as high as $60 per ton by the time a burning plant opens.

Such rises in dumping fees do not translate proportionately into higher residential rates, since garbage hauling is more expensive than its disposal. Preliminary estimates are that burning, instead of burial, might push rates up 15 to 20 percent.

City engineers also expect that an environmental impact statement would demonstrate that the true cost of landfills - which includes pollution, land loss, fuel costs for long distance trucking and energy not generated - makes burning trash a bargain. To get garbage out of sight and out of mind at Cedar Hills requires hauling it from transfer stations as many as 40 miles away.

Surprisingly, however, the environmentalists one would expect to embrace a garbage-to-energy plant are among its toughest critics. Some objections:

- The in-city location. Some argue that even though metropolitan areas produce the garbage, it should be disposed of as far from people as possible. Garbage disposal in Seattle is not new - there are 19 former dumps within the city limits, including the Montlake parking lot at the University of Washington, the UW arboretum and Genesee Park. Also, the box-like garbage-burning plants, whatever facade architects dream up for them, are big and conspicuous.
- Only 20 percent of Seattle's garbage is recycled, primarily by industry. While city officials are skeptical that people can be persuaded to

change their throwaway habits, some environmentalists fear that burning, which requires a constant stream of waste to be economically effective, will dampen city interest in recycling. Joan McGilton, environmental engineer for the city, said the real problem is not collecting recyclables but finding a market for them. "It is still more expensive to make glass from used glass than the initial raw materials," she said. The city plan, however, proposes to encourage recycling to at least 30 percent as well as burning.

- Seattle also plans to use the simplest and most proven technology, which essentially throws everything into the furnace without sorting recyclables out. While the city said sorting has had little success in other cities, environmentalists are reluctant to approve a plant that does not attempt any recycling effort.
- Any waste-to-energy plant within the city will increase garbage-truck traffic for its immediate neighbors and emit some pollutants, probably invisible. McGilton said technology exists to reduce emissions to safe levels, but potential pollutants include dioxin, highly toxic if concentrated, and chlorides that could combine with water to form hydrochloric acid. In other words, acid rain. The environmental impact statement will determine how much of those pollutants could be scrubbed out of plant emissions.
- Some question the "big-is-cheaper" philosophy of the city planners. While Birks argues about economy-of-scale, people at recent meetings suggested several alternatives. Among them: Two smaller plants, or a down-scaled plant with more recycling, or tiny neighborhood plants dotted around the city to generate steam and power for local businesses and schools.
- Some opponents are suspicious of suggestions to put garbage in the hands of a profit-making industry. Others fear City Light will pay artificially high prices for the generated electricity, thus subsidizing garbage burning with power rates.

There have been other, more bizarre schemes to dispose of garbage. A Troutdale, Oregon man has suggested a $2.2 billion garbage slurry pipeline, pumping the Willamette Valley's waste and water across the Cascades into a huge central Oregon dump.

A Seattle man recently suggested shipping it by barge and dumping it on Puget Sound wetlands to create waterfront homesites.

Several pundits have suggested conveyor belts up to the craters of Mount Rainier or Mount St. Helens.

DOE's John Conroy suggested, tongue in cheek, that everyone dig their own landfill trench in the backyard. "It's when you put all the garbage in one place that you have problems," he said.

Ironically, added Gary Brugger of DOE, success at cleaning the air and water has tended to increase ground pollution problems, because the denser pollutants often are buried. Burning has the potential of reducing volume of waste and making it more inert.

Waste-to-energy enthusiasts realize they have a selling job on their hands. "We have such a poor record of managing existing facilities," said Bob Jurica, director of Whatcom County's solid waste division, "that people are distrustful of anything officials might propose."

Source: "Garbage: A Burning Issue." April 8, 1984, Sunday edition of the
Seattle Times/P.I. Reprinted by permission of the Seattle Times.

TURNING GARBAGE TO ENERGY

1 Garbage trucks dump unsorted refuse into an indoor receiving pit. Artificially lowered air pressure prevents odor from escaping outdoors.

2 Overhead cranes lift the trash and feed into the furnace through a hopper.

3 Inside the furnace, moving grate bars mix the garbage to feed in air and ensure complete burning at 1,800 degrees.

4 A vibrating feeder sifts out ashes, 10 percent of original volume, for transport to a landfill.

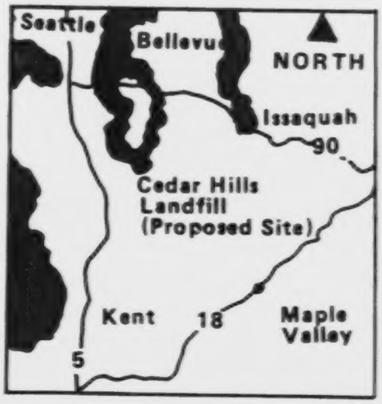
5 Heat generates superheated steam, which turns a turbine generator and produces electricity.

6 An electrostatic precipitator or similar pollution scrubber removes smoke and dust particles from the emissions.

7 A smokestack emits what are ideally invisible, odorless, harmless gases to the atmosphere.

THE PAYOFF

Seattle's proposed $200 million plant could generate 40 to 50 megawatts and light 25,000 homes, earning $85,000 to $110,000 in power revenues per day.



PLUS AND MINUSES

+ Useful energy from garbage.
− May discourage recycling.
+ Reduces need for polluting landfills
− May create air pollution.
+ Consumes garbage where it's produced.
− Sited in a Seattle neighborhood.
+ Profitable, proven technology.
− Past fiascos, higher rates.

TITLE: CALORIES IN FOOD

USE WITH: You're Eating More Energy Than You Think!, p. 155, and How To Calculate BTU's Per Container, p. 152

RATIONALE: The chemical energy in food can be converted to heat energy. This can be measured. Heat energy can be used to provide power. (Refer to activity How to calculate BTU's Per Container, p. 152)

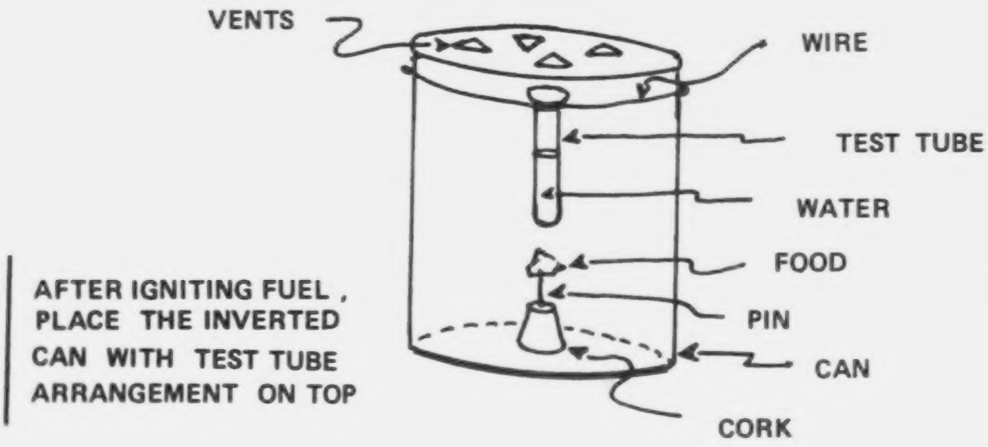
SUBJECT: Science

GRADES: 7, 8

LEARNING OUTCOME: By conducting the following experiment students will learn that the chemical energy in food can be converted to heat energy. They will see that in throwing away food they are throwing away energy and they will learn that solid waste can be used as a source of energy to provide power. (Note: This is a crude facsimile of an actual scientific instrument and will achieve only illustrative measurement results.)

MATERIALS: can, cork, pin, wire, test tube, marshmallow, peanuts

LEARNING PROCEDURE:



AFTER IGNITING FUEL, PLACE THE INVERTED CAN WITH TEST TUBE ARRANGEMENT ON TOP

1. Weigh marshmallow or peanut.
2. Measure temperature in centrigrade of a known weight of water.
3. Burn marshmallow or peanut to heat H_2O in test tube.

4. Measure temperature (C) of H_2O after marshmallow or peanut is burned up.

5. Use the following formula to calculate calories gained by the H_2O:

    a. Mass of H_2O x change in temperature = calories.

    b. To calculate calories per gram: divide calories by grams of marshmallow or peanut.

6. Discuss: What materials normally thrown away could be used in place of the marshmallow or peanut?

7. What technology would have to be available in order to convert solid waste to energy? How could this energy be used? (See the activity The Road to Recovery, p. 297)

8. What are the advantages and disadvantages of using solid waste as a source of fuel (Advantages: Provides a large capacity solution that requires no change in public waste disposal habits. Disadvantages: Pollution produced by burning waste, constant large amount of waste needed, very expensive high technology facility needed to burn waste, the energy in food, rather than providing nutrition, is partially wasted.)

PRE & POST
TEST QUESTIONS:

How could solid waste (garbage) be used as a source of fuel?

How could this fuel produce energy?

BIBLIOGRAPHY:

Peterson, Christina, et al. Energy, Food and You. Seattle, Wa.: Wa. State Office of Environmental Education, N.W. Section. Revised Edition, 1983.

TITLE: IT'S A GAS: VERSIONS I AND II

RATIONALE: There are renewable sources of energy to supplement the nonrenewable sources we are now depleting. Rather than being thrown away, certain solid wastes can become sources of energy. ". . . at least 1,000 of the 15,000 sanitary landfills in the United States are big enough and deep enough to yield sizable quantities of methane."[1]

SUBJECT: Science

GRADES: 7-12

LEARNING OUTCOME: By constructing a classroom-size model methane generator, students will:

- Understand the energy-producing potential of some solid wastes.
- Understand systems of generating methane from wastes.

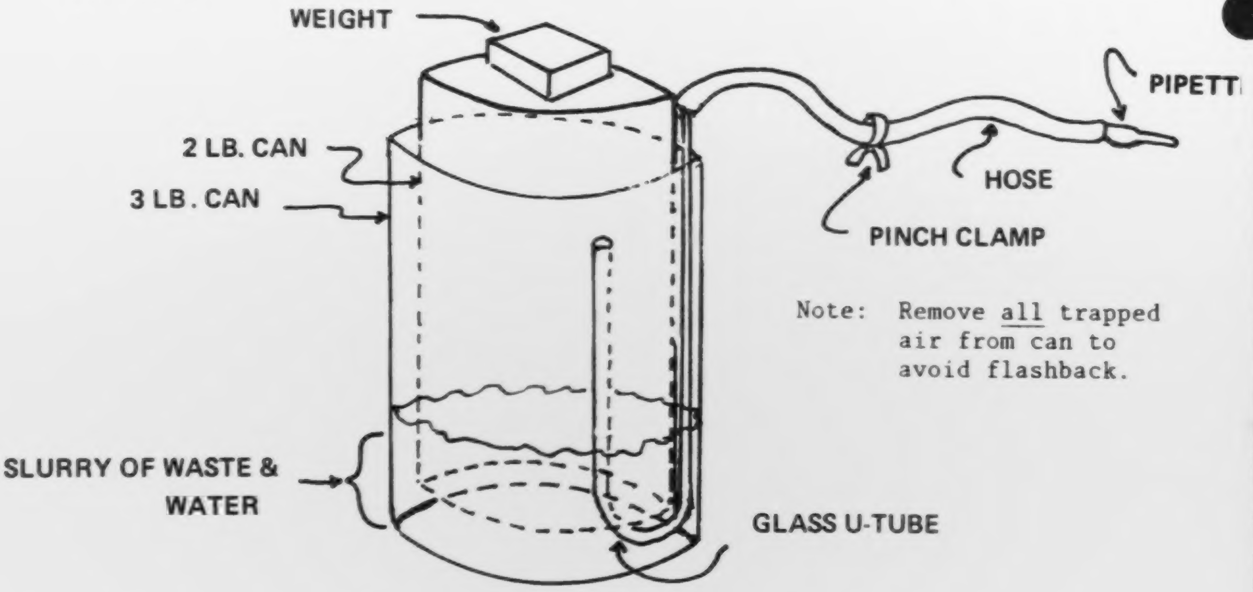
MATERIALS: One wide-mouth jar (or a 2-pound coffee can) that will fit in a 3-pound coffee can (or like cans), one foot of glass tubing, or a "U" tube, 3 inches of surgical tubing, and the nozzle from a medicine dropper, one pinch clamp.

LEARNING PROCEDURE:

1. Place organic waste material such as lawn clippings, plant or vegetable tops, animal manure with water in the larger can to about two-thirds full. Bend the glass tube into a "U" shape at the middle and run it outside and up. See diagram. Place a nozzle and a pinch clamp on the hose. Push can down and keep can warm (60-90°F). Place a small rock on the top of a can that has been inverted over the waste mixture and open the pinch clamp. This will allow the can to sink. Seal off the tube with the clamp, and, as the gas is generated, the can will rise. Caution: Do not place such a large rock on the can that it cannot rise or the waste material will overflow as it is displaced. To avoid the buildup of an overabundance of gas, limit the amount of waste put in the generator. Remove all trapped air from can (or jar) to prevent flash-backs when burning the methane. Allow the generator to function until all trapped air is flushed from can or jar. Students may want to build several of these and test the generating ability of different materials.

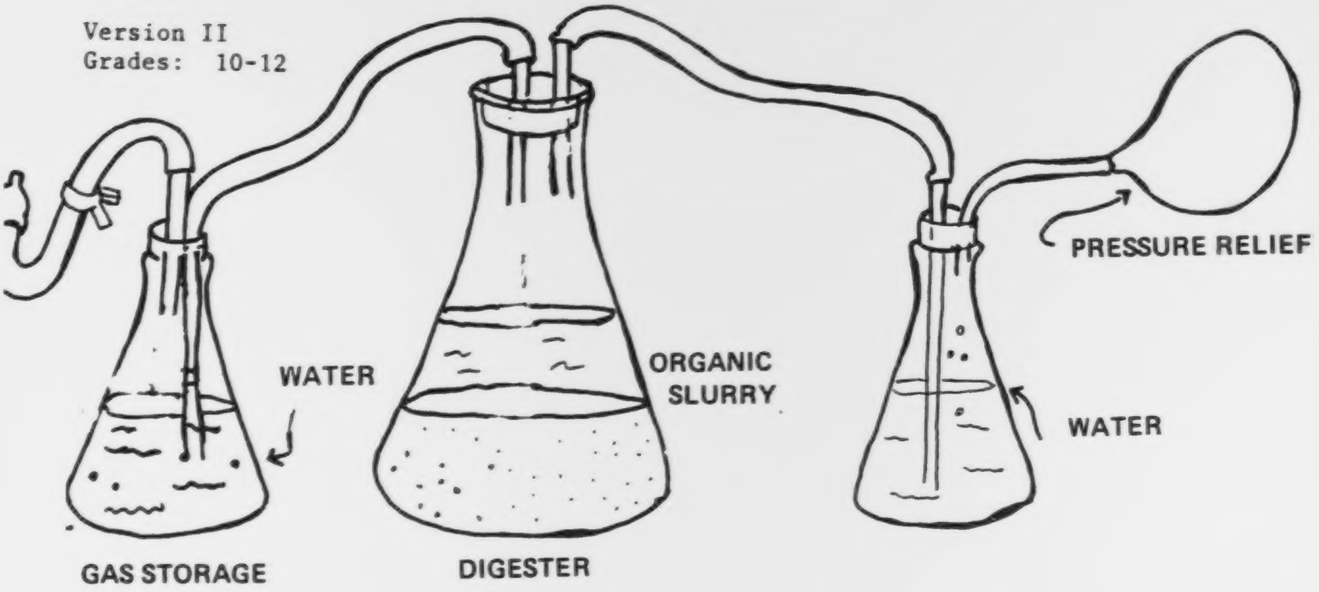
   NOTE: Experiments can be done to calculate the number of BTU's produced; the volume of gas per material used; the amount of gas it takes to heat water.

Version I


WEIGHT
PIPETT
2 LB. CAN
3 LB. CAN
HOSE
PINCH CLAMP
SLURRY OF WASTE & WATER
GLASS U-TUBE

Note: Remove all trapped air from can to avoid flashback.

Version II
Grades: 10-12


PRESSURE RELIEF
WATER
ORGANIC SLURRY
WATER
GAS STORAGE
DIGESTER

1. Fill digester about 1/2 full with an organic slurry (i.e., manure and/or ground grass clippings, etc.). Mix with water until a thick, but pourable, consistency is reached.

2. Bore two holes in a rubber stopper with a cork borer.

3. Run a tube to a gas storage container. (NOTE: Make sure all connections are tight. Use vaseline on cork holes.) The container's lid should have two holes, one for the tube coming from the digester and one for a nozzle and clamp -- this is your flare.

4. Run a tube to a pressure relief system. Use an easily expandable container or a balloon that's been blown up several times. Make sure tube from digester extends down into the water. This arrangement will prevent an excess of gas from feeding back into the digestor.

5. Build four or five and have students test different organic wastes. Which produces the most gas the fastest? Which waste produces the best fuel?

EXTENDED
LEARNING:

1. Have students research the historical uses of methane gas digesters. Example: In Holland, a tarp was placed over a portion of a swamp with a hose running from under the tarp to the house for light and heat.

2. Examine modern methane technology.

   a. Use of digester at Monroe Reformatory Honor Farm, Monroe, Washington.

   b. Use of basic design in India/Pakistan/China for small scale home heating/cooking/lighting. (See "The Fascinating World of Trash" National Geographic, April, 1983, as cited in the Bibliography.)

3. Have students research the available composting toilets on the market today. For example: Clivus Multrum, Ecolet, etc. . .

   a. How do they work?

   b. Cost vs. benefits

   c. What impacts would they have on city sewage problems?

   d. Where are they best used?

4. Study resource recovery technology to learn how industrial fuel is created from solid waste by pyrolysis.

PRE & POST
TEST QUESTIONS:

What is methane?

How is it produced?

List materials that can be used to generate methane.

Describe another means of using solid waste to produce fuel.

SOURCE: [1]White, Peter T. "The Fascinating World of Trash." National Geographic. April, 1983, Vol. 163, No. 4. P. 440.

BIBLIOGRAPHY:

Peterson, Christina et al. Energy, Food and You, Secondary Guide. Seattle, Wa.: Wa. State Office of Environmental Education, N.W. Section. Revised Edition, 1983.

TITLE: WASTE TO ENERGY - An activity to accompany the ten-minute filmstrip "Waste to Energy," available from Washington State Department of Ecology (see p. 343).

USE WITH: The Road to Recovery, p. 297.

RATIONALE: Using high technology, recovery processes can turn various forms of waste into usable energy.

SUBJECT: Science, Social Studies, Government, Contemporary Problems

GRADES: 9-12

LEARNING OUTCOME: Students will learn about different resource recovery processes and evaluate the usefulness of resource recovery as a solid waste management option.

LEARNING PROCEDURE:

1. View the filmstrip and answer the following questions:

   a. Explain what a "waste to energy" plant does.

   b. List three kinds of recovery plants. Briefly describe the function of each one.

      ●

      ●

      ●

2. What is R.D.F.?

3. Do recovery plants compete with recycling centers? Explain your answer.

4. In your opinion, are recovery plants necessary? Why or why not? In your answer, include availability of land, volume or recoverable materials, benefits to a city, air pollution, and other environmental considerations.

PRE & POST TEST QUESTIONS:

What does a "Waste to Energy" plant do?

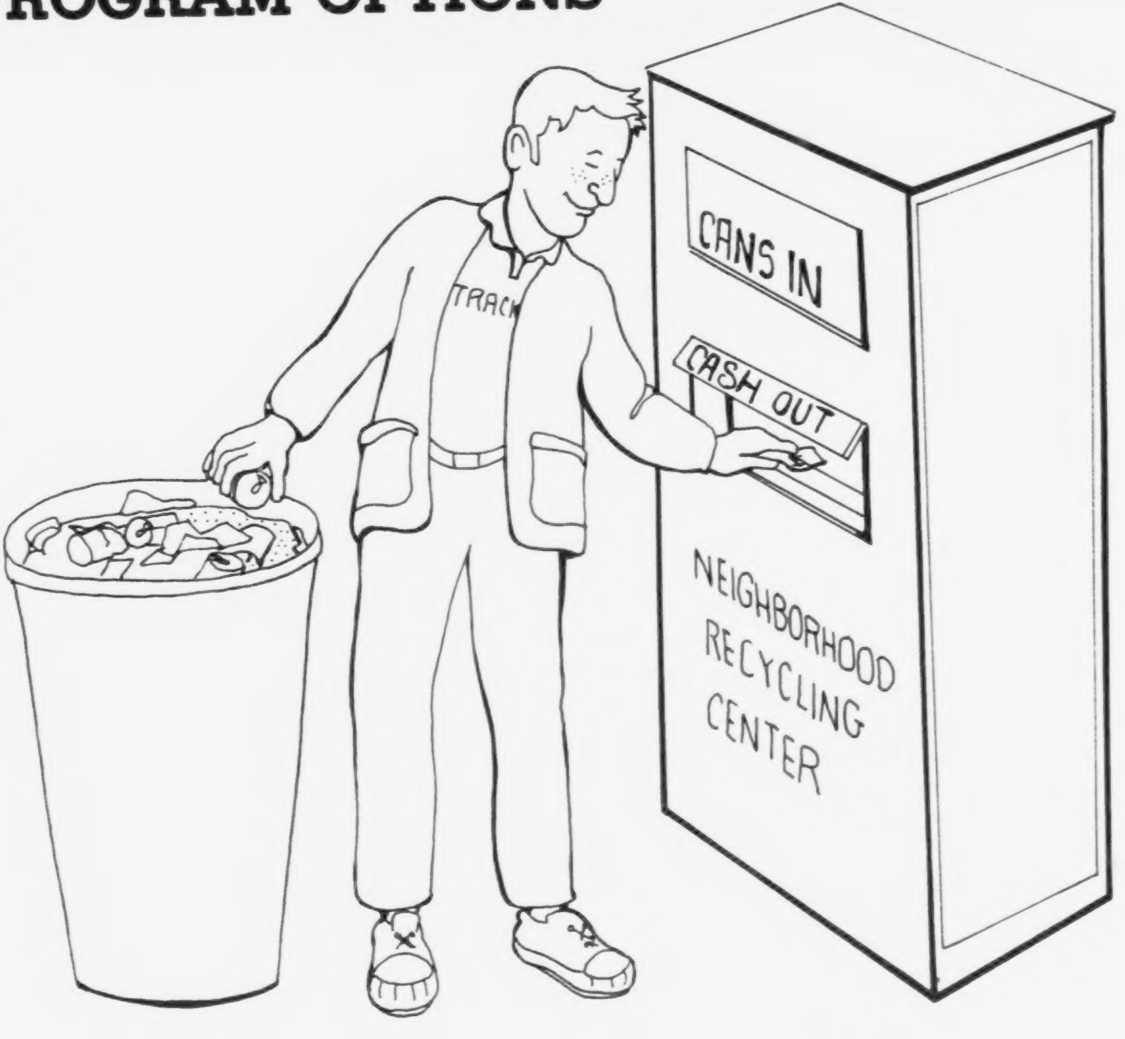
Under what circumstances might "Waste to Energy" plants be necessary?

Which costs more, landfills or recovery plants?

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Waste to Energy. California Solid Waste Management Board, 1980, Filmstrip/tape, 10 min., color.

SCHOOL RECYCLING PROGRAM OPTIONS


TRACK
CANS IN
CASH OUT
NEIGHBORHOOD RECYCLING CENTER

SCHOOL RECYCLING PROGRAM OPTIONS

This section of A-way With Waste shows schools how they can become involved in recycling.

A carefully designed recycling program gives students the chance to put into action the values and attitudes promoted in the elementary and secondary activities. It meets needs of students to be involved in practical, hands-on, economically rewarding school projects. Participating in a school recycling program shows students how their classroom skills can be usefully and profitably applied to the solving of real problems. Participation introduces secondary school students to the procedures of managing a business as well as making them aware of skills needed for possible future careers and summer job opportunities with the Department of Ecology's Youth Corps. And by running a school recycling program, students will have the chance to do something that is beneficial not only to the school but to the entire community as well.

The Benefits of a Recycling Program for Teachers and the School District.

A school recycling program can reduce the amount of solid waste produced by the school and the cost of waste disposal. Not having to pick up and dispose of solid waste frees custodians for more important tasks.

Participating in a recycling program can help the district meet career education requirements and goals.

A recycling program can generate funds for school programs. For example, the Mercer Island Recycling Center, run by students of Mercer Island High School, has offered to help the district fund its Environmental Studies Department. In 1984, the Mercer Island High School program earned $27,000. Seattle's Our Lady of the Lake School generates about $180 a student with its recycling program each year.

A recycling program promotes cooperation between teachers and students and encourages teachers to create curriculum with immediate practical application.

The Benefits for the Community of a School Recycling Program

The community benefits from a school recycling program because the cost of solid waste disposal is reduced. Landfills fill up more slowly and the community has a nearby, reliable recipient for recyclables. Recyclers in the area benefit from an increased flow of recycled material and are given the chance to help educate students and parents about the importance of recycling solid waste. Parents are provided ways to get involved with their children's school life. Most important, a well-run school recycling program can improve relations between the community and the school district with the school acting to beautify the area and serve as a community center.

School Recycling Program Options

Schools can get involved in recycling in the following ways:

1. Establish a school account at the local recycling center. Payments for materials brought in by parents and community members can, in this way, be credited to fund school projects.

2. Conduct occasional school drives. Recyclables can be stored at home until the time of the drive.

3. Have students assist community groups already active in recycling.

4. Set up bins and drop boxes for the recyclables generated by the school. Regularly deliver, or arrange for the pickup of, these materials by the local recycler. The Northwest School in Seattle operates an in-school recycling program of this kind.

5. Operate a short-term recycling center at school to collect materials from home for fund-raising projects.

   Schools successful with the recycling projects outlined above and wishing to undertake more far-reaching, long-term recycling efforts should contact the WDOE School Program Coordinator for assistance.

Which Option is Right for Your School?

Various considerations need to be taken into account when determining which recycling option is right for your school. Some first steps in helping you decide:

1. Contact the WDOE toll-free Recycling Hotline (1-800-RECYCLE) to find out if there is a nearby recycling facility that could support your program. If yes, contact the recycler to determine what services and payment he or she might provide (e.g., bins, materials accepted, hauling of recyclables, current prices paid for materials, etc.).

2. Investigate other organizations in the community that regularly recycle and that might offer competition (e.g., Kiwanis recycling aluminum). If this is the case, could you work in cooperation?

3. Have students develop and distribute in the school, to parents, and to the community a survey that would determine:

   a. How many students would be interested in participating in a recycling program.

   b. If parents and community members keep recyclable materials separated and stored at home. If not, would they be willing to do so?

   c. If parents and community members would be willing to bring recyclable materials to the school or school-maintained recycling bins.

d. How much material the school would be willing and able to handle.

e. How materials would be transported to the school and to the recycler.

Step-By-Step Procedure for Long-Term Recycling Programs

Evaluate the results of your initial investigation to determine the degree of recycling activity appropriate for your school. If your school decides to set up a school recycling program or establish a full-line donation recycling center for the community, then the following step-by-step procedures should be used.

Step 1.

Carefully consider the extensive commitments in time and equipment needed for the success of a long-term recycling program. Remember that the goal of any school recycling is not only to increase recycling and reduce waste, but to strengthen the local recycling industry.

Contact the School Program Coordinator at the Washington State Department of Ecology's Redmond Office, (206) 885-1900, SCAN 8-241-2610. Arrange for a WDOE representative and a recycler to meet with the school district superintendent or school principal to introduce the WDOE's School Program and to explain how WDOE can help the school district. The Recycling Hotline 1-800-RECYCLE will refer schools to the recycling industry and manufacturers of recyclable materials. WDOE will provide the A-way With Waste curriculum, teaching materials, and live presentations as part of the school program and the recycler can lend practical advice and assistance.

The WDOE representative will:

1. Explain how the K-12 classroom activities in the A-way With Waste teacher's guide can help create knowledge and awareness of the need for school recycling programs.

2. Describe the benefits of a school recycling program.

3. Emphasize the school commitment necessary for implementation of a recycling program.

4. Assure the school district of WDOE support.

5. Describe possible rewards as incentives for successful programs.

6. Ask the superintendent to select possible program leaders who would be instrumental in the program promotion.

7. Meet with those people identified as potential project leaders to explain the program and enlist their support. The WDOE representative will continue to meet with these people in an advisory capacity.

Step 2.

1. School project leaders contact student groups potentially responsible for program initiation and operation. Consideration should be given to developing a structure for ongoing, year-to-year management of the recycling program.

2. Evaluate the "Which Options Are Right For You" recycling survey to determine the scope of the project.

3. Write a letter to be distributed at school and to be sent home or to businesses explaining the benefits of the school recycling program and requesting support of the program.

4. Estimate possible costs:

   - cost of renting storage space
   - facility construction costs
   - supplies and equipment
   - transportation of materials
   - insurance
   - maintenance cost
   - utilities
   - wages

5. Investigate possible funding sources for initial costs:

   - school recycling drives for start-up cash
   - PTA
   - local service clubs
   - local businesses
   - student body general fund
   - student stock option

6. Evaluate possible site locations in terms of:

   - obtaining permission from landowner
   - accessibility
   - visibility
   - nuisance factors (noise, smell)
   - ordinances (health, fire, zoning)
   - characteristics of materials to be recycled

7. Evaluate surveys, project scope, economics, and location/storage considerations to decide which materials will be recycled.

8. Present results of feasibility study to school staff (faculty, secretaries, custodians, cooks) for approval and support. Outline the benefits for students, school, and community described in the introduction of this recycling program plan.

Step 3. Plan and develop the Recycling Facility

1. For the full-line recycling center, determine if the center will be a staffed center or an unstaffed drop-off point. Consider the following:

    - location
    - project scope
    - worker availability

2. Design a school facility or community recycling facility, taking into account site location, materials being recycled, space needed for covered and uncovered storage, level of participation, and potential for expansion. Consult recyclers on design specifics (e.g., vandal-proofing, ramps for moving barrels, access/egress, etc.)

3. Develop management structure to cover listed responsibilities:

    a. Supervisor - faculty director coordinates overall program

    b. Supervisor and students:

        - evaluate all project components and reporting procedures
        - describe and promote the project to those interested
        - enforce fire, health, and safety regulations
        - decide how funds, including profits, are disbursed

    c. Student responsibilities:

        - scheduling worker hours and pickup schedule
        - keep records of material flow
        - accounting
        - stacking and storing recyclables
        - maintaining good public relations -- handling complaints, publicity and promoting the program
        - maintaining and cleaning the site

4. Outline student pay and benefits for working in the center. For example:

    - Students may earn a wage for their hours worked.
    - Students may earn credit for their club in lieu of direct payment.
    - Students may earn class credit for work in the center.
    - Students may earn credit for school or community service.

5. Obtain adequate insurance covering student workers and transportation of materials and liability insurance covering the center's operation. (Check school insurance covering students.)

6. Scheduling:

    - Establish practical hours for the center to be open. It is highly recommended that the school's recycling program and materials pickup continue in the summer to ensure service to contributors.

- Establish a schedule for transportation of collected materials to the recycler. Base this schedule on the flow of materials and size of the center's storage space.

7. Facility regulations and operating instructions:

   - Post fire, health, and safety regulations so anyone using the bins or working in the center will be aware of them.
   - Post clear instructions telling people how to prepare recyclables for student handling (i.e., glass separated, returnable/nonreturnable or by color; newspaper stacked and tied; tinned cans cleaned, both ends removed and flattened, etc.)
   - Post opening and closing procedures for workers.
   - Additional signs should include WDOE Recycling Hotline number (1-800-RECYCLE) and the number of local recyclers so people visiting the center may obtain more information about recycling. In addition, phone numbers for complaints or information should be posted so school officials and secretaries will not be bothered unnecessarily.

SOLID WASTE FACT SHEET

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SOLID WASTE FACT SHEET

In the United States almost one ton of solid waste per person is collected annually from residential, commercial, and institutional sources. At the present rate of disposal, about 500 new dumping locations must be found each year. Source: U.S. Department of Agriculture, Our Land and Water Resources: Current and Prospective Supplies and Uses. U.S. Government Printing Office, Washington, D.C. 1976.

The lifetime garbage of the typical American will equal at least 600 times his or her adult weight. Source: Denis Hayes, Repairs, Reuse, Recycling - First Steps Toward A Sustainable Society. Worldwatch Paper 23. The Worldwatch Institute. 1776 Massachusetts Ave. N.W., Washington, D.C. 20036, 1978.

The world is now generating between 500 million and a billion tons of solid waste per year and those figures could double every 15 years. Source: U.S. News and World Report, "Rumors of Earth's Death Are Greatly Exaggerated." May 9, 1983. p. 84.

"Americans produce 154 million tons of garbage every year -- about 1,400 pounds per person. That's enough to fill the New Orleans Superdome, top to bottom, twice a day, every day. The real problem with this is the fact that more than half of this waste is still recyclable. Estimates vary, but currently the United States appears to be recycling less than 10 percent of its municipal solid waste. This puts us way behind European countries like Denmark, which recycles an impressive 60 percent of its waste." Source: Dennis Moore, "Recycling: Where Are We Now?" New Shelter. Feb., 1982. p. 58.

Given population and the information from U.S. News and World Report and New Shelter, Americans comprise about 5 percent of the world's population and annually produce between 15 and 38 percent of the world's garbage.

The nation's 15,000 landfills occupy about 476,000 acres. Source: Peter T. White, "The Fascinating World of Trash" National Geographic Magazine April, 1983 and Denis Hayes, Worldwatch Paper 23. (Full citation above)

One thousand tons of uncompacted waste would cover a half-acre of land three feet deep. (The City of Seattle generates (1983) 1,200 to 1,300 tons of solid waste a day.) Sources: U.S. News and World Report, Washington Department of Ecology and Conrad Lee, City of Seattle, Engineering Department, Solid Waste Utility, 1983.

In the United States, in 1978, waste disposal cost approximately $4 billion a year. In many cities, expenditures for waste management were second only to those for education. Source: Denis Hayes, Worldwatch Paper 23. (Full citation above)

In Seattle, the cost of residential and commercial waste disposal has increased 55 percent in the last five years, or about a million dollars a year. In Snohomish County, the cost of waste disposal increased fivefold between 1979 and 1983. Sources: Conrad Lee, City of Seattle, Engineering Department, Solid Waste Utility and Allen Fitz, Resource Recovery Engineer, Snohomish County Department of Public Works, 1983.

Throwing away an aluminum beverage container wastes as much energy as pouring out a can half-filled with gasoline. Failing to recycle a daily edition of the Washington Post or London Times wastes just as much. Source: William U. Chandler, Materials Recycling: The Virtue of Necessity. Worldwatch Paper 56. The Worldwatch Institute, 1776 Massachusetts Ave. N.W. Washington, D.C. 20036. 1983.

If you drink two aluminum cans of beer or soft drinks per day and fail to recycle the cans, you waste more energy than is used daily by each of a billion human beings in poorer lands. Source: 1978 Family Energy Watch Calendar. ConservAction. Washington State S.P.I. and Wa. State Energy Office, Olympia, WA.

Making aluminum from recycled aluminum uses 90 to 95 percent less energy than making aluminum from bauxite ore. Source: William U. Chandler Worldwatch 56. 1983. (Full citation above)

In 1972, only 15 percent of all aluminum cans were recycled in the United States; in 1981, 54 percent were recycled. Source: Chandler, Worldwatch 56, 1983,. (Full citation above)

Making paper from recycled paper uses 30 to 55 percent less energy than making paper from trees and reduces the air pollution involved in the paper making process by 95 percent. Source: Chandler, Worldwatch 56. (Full citation above)

About 70 percent of all metal is used just once and then discarded. The remaining 30 percent is recycled. After five cycles, only one-quarter of one percent of the metal remains in circulation. Source: Denis Hayes, Worldwatch 23. 1978. (Full citation above)

Only about one-fourth of the paper, aluminum, iron, and steel used in the world is recovered for recycling. Source: Chandler, Worldwatch 56. 1983 (full citation above)

In 1982 nearly 20.3 million pounds of litter were discarded in Washington State. (Source: Daniel B. Syrek, Washington Litter. The Institute for Applied Research, Sacramento, Ca. 1983). That's 4.4 pounds of litter per person. On the bright side, in 1983, the state total had fallen to 3-3/4 pounds per person. Washington State has achieved a 10 percent reduction in litter every year since 1977. Source: Syrek, Washington Litter.

In 1982 the Washington State Model Litter Control and Recycling Act, funded by industry, spent $639,097 through the Department of Ecology's Youth Corps for litter pickup in Washington. In 1982, the Youth Corps picked up 648 tons of litter and earned over $9,000 by recycling. Source: Washington Department of Ecology, Youth Corps Program.

Washingtonians recycle nearly 400,000 tons annually. Source: Washington Department of Ecology Litter Control and Recycling Program Fact Sheet. In 1981, 10 percent of Washington's waste was recycled saving $36.5 million in disposal costs and the equivalent of 2.2 million barrels of oil in energy costs. Source: Washington Department of Ecology Recycling Hotline. 1-800-RECYCLE.

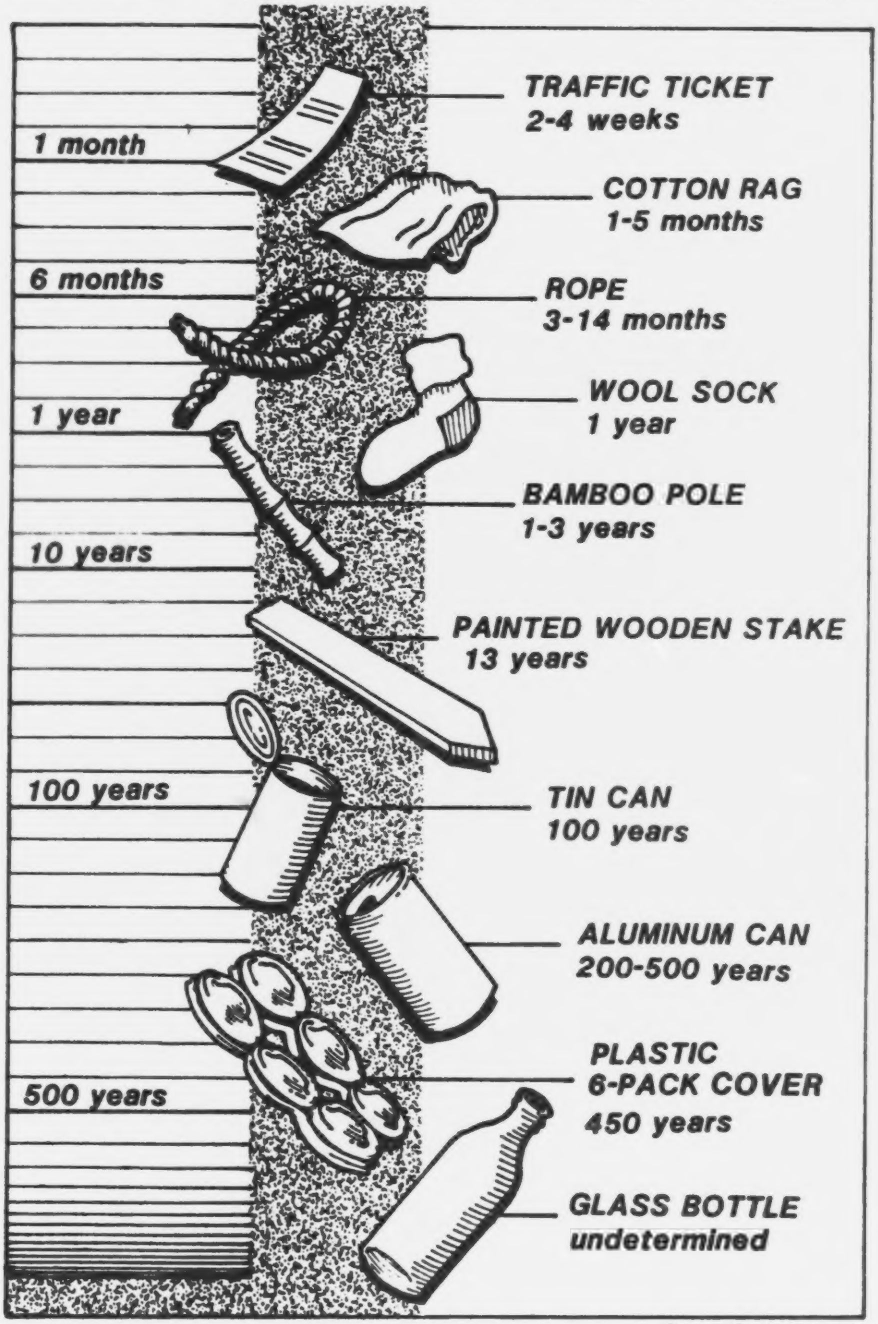
The total weight of packaging used by each of us between 1958 and 1971 increased by 44 percent -- from 404 pounds each in 1958 to 525 pounds in 1971 to a predicted 661 pounds in 1976. Source: Oregon Department of Environmental Quality. Recycling Information Office, Portland, Oregon.

Each year, Americans throw away approximately 60 billion cans, 28 billion bottles, 4 million tons of plastic, 40 million tons of paper, 100 million tires and 3 million cars. Source: Environmental Protection Agency. Office of Waste Management, Washington, D.C. 1980.

Paper, the single largest component of what we throw away, comprises 50 percent of the volume of America's solid waste. Americans each use 580 pounds of paper a year, the highest consumption in the world. In the U.S. South and East Coast regions, an "average" tree used to make pulp for printing and writing paper would probably weigh about 500 pounds. This 500 pound tree, after processing through the paper making system, would probably make about 100 to 150 pounds of paper. A typical pulp and paper mill would require approximately 27 million BTU's of energy to make a ton of paper. Another way of looking at this would be to say that one gallon of "oil equivalent" would make approximately 11 pounds of paper. A typical mill would probably use in the range of 25 to 35 gallons of water to produce a pound of paper. This information suggests that each year every American uses the equivalent in paper of between 3.8 and 5.8 trees. Making one American's paper consumption of 580 pounds requires about 7,830,000 BTU's of energy and between 14,500 and 20,300 gallons of water. Sources: Dennis Moore, "Recycling: Where are We Now?" Full citation above. William U. Chandler, Worldwatch Paper 56. Full citation above. Scott Paper Company, Consumer Information Center, Scott Plaza, Philadelphia, Pennsylvania 19113.

Enduring Litter

Litter at the roadside is ugly. How long it will stay before decaying may be an ugly surprise.



Source: Book of Lists 2

GLOSSARY

biodegradable -

The property of a substance that permits it to be broken down by microorganisms into simple, stable compounds such as carbon dioxide and water.

BTU -

British thermal unit, a measurement of heat, the amount of heat needed to raise the temperature of one pound of water 1° Fahrenheit.

composting -

Collecting organic material such as lawn clippings, leaves, kitchen scraps, and manure to be layered so as to decompose into fertile humus.

conservation -

The preservation of natural resources from loss or waste.

consumer -

A person who buys goods or services for his own needs and not for resale or for production of other goods for resale: as opposed to producer.

cycle -

circle, return, occur again.

decibel -

A unit of intensity of sound, equal to 20 times the common logarithm of the ratio of the pressure produced by the sound wave to a reference pressure. A measurement of 50 decibels is considered moderate sound; 80, loud; and 100, the level beyond which the sound becomes intolerable.

decompose -

To break down, come apart, change form.

dump -

Now illegal, dumps were open unsanitary disposal sites used prior to sanitary landfills.

(verb) To throw away garbage or solid waste in a place set apart for that purpose.

illegal dumping - To unlawfully throw away garbage or solid waste in any place not authorized to accept waste material.

ecology -

The scientific study of the relations of living things to one another and to their environment. A scientist who studies these relationships is called an ecologist. From Greek "oikos" - house (home) - knowledge of our "home" - the earth, air and water.

ecosystem -

A system made up of a community of living things and the physical and chemical environment with which they interact.

energy -

The capacity to perform work or produce a change from existing conditions and quantified as a force operating through a distance.

energy recovery facility -

A resource recovery plant with the prime purpose of generating energy by burning solid waste.

energy resources -

Resources used as sources of power and/or heat generation. Renewable: wood, hydro, biomass, and others; nonrenewable: coal, petroleum, natural gas, uranium and others.

environment -

All the conditions, circumstances, and influences surrounding and affecting the development or existence of people or of nature.

ferrous metals -

Metals composed mainly of iron, and generally magnetic

garbage -

Originally, spoiled or waste food that was thrown away; now, any material considered worthless, unnecessary or offensive - usually thrown away.

Gross National Product (GNP) -

The total market value of all the goods and services produced by a nation during a specified period.

hazardous (dangerous) waste -

Those wastes which provide special problems to living creatures or the environment because they are (a) poisonous, (b) explosive, (c) attackers or dissolvers of flesh or metal, (d) readily burnable - with or without a flame (e) carriers of diseases or (f) radioactive. Some wastes cause only one problem. Others combine several of the above.

inorganic -

Designating or composed of matter that is not animal or vegetable; not having the organized structure of living things. Most inorganic compounds do not contain carbon and are derived from mineral sources.

household hazardous waste -

Substances used in the home that have some or all of the characteristics of hazardous waste.

landfill -

A site for the burial and decomposition disposal of solid waste.

leachate -

Liquid that has percolated through solid waste and/or been generated by solid waste decomposition and has extracted, dissolved, or suspended materials in it. This liquid may contaminate ground or surface water. Leachate is particularly a problem in areas of high rainfall and porous, sandy-gravelly soils.

litter -

Waste materials carelessly discarded in an inappropriate place. Littering is against the law.

methane -

A colorless, odorless, flammable gaseous hydrocarbon (Ch_4) present in natural gas and formed by the decomposition of vegetable matter. It can be used as a fuel.

natural resources -

Valuable, naturally occurring materials such as wood or minerals.

nitrogen cycle -

The continuous cyclic progression of chemical reactions in which atmospheric nitrogen is compounded, dissolved in rain, deposited in the soil, assimilated and metabolized by bacteria and plants, and returned to the atmosphere by organic decomposition.

nonferrous metals -

Metals which contain no iron, such as aluminum, copper and brass.

nonrenewable resources -

Natural materials which, because of their scarcity, the great length of time required for their formation, or their rapid depletion, are considered finite, i.e., exhaustible.

organic -

Derived from living organisms. Also, designating any chemical compound containing carbon.

packaging -

A commodity's wrapping or sealing, sometimes designed to attract purchasers.

pollution -

Harmful substances deposited in the air, water or on land, leading to a state of dirtiness, impurity, or unhealthiness.

precious metals -

Rare and costly metals such as silver, gold, and platinum.

rationale -

A statement or explanation of fundamental reasons.

resource recovery -

Use of high technology to burn mixed solid waste and produce energy and, in some cases, industrial fuel. Resource recovery may involve mechanical separation of recyclables before or after burning.

resource recovery plants -

Facilities which employ highly technical burning techniques to produce salable energy from solid waste.

recycle -

The collection and reprocessing of manufactured materials for reuse either in the same form or as part of a different product.

recycling center -

A site where manufactured materials are collected and resold for reprocessing

Types of recycling centers are:

certified -	A center commended by the Washington Department of Ecology Hotline Program for accepting at least four recyclable items and offering six days a week "one stop" recycling.
buy-back -	A center where the recycler pays for materials.
donation -	A center where the recycler accepts donated materials.
drop-off -	An unattended donation station.

renewable resource -

A naturally occurring raw material or form of energy derived from an endless or cyclical source, such as the sun, wind, falling water (hydroelectric), biofuels, fish, and trees. With proper management and wise use, the consumption of these resources can be approximately equal to replacement by natural or human-assisted systems.

reuse -

To extend the life of an item by repairing or modifying it, or by creating new uses for it.

revise -

To change our attitudes and improve our knowledge of solid waste in order to realize both the scope of the problem and our responsibility for its solution through careful buying and responsible waste disposal.

sanitary landfill -

A specially engineered site for disposing of solid waste on land constructed so that it will reduce hazards to public health and safety. Sanitary landfills designed to Federal Resource Conservation and Recovery Act standards require, among other things, an impermeable lower liner to block the movement of leachate into ground water, a leachate collection system, gravel layers permitting the control of methane, and daily covering of garbage with soil.

sludge -

Any heavy waste deposit, sediment, or mass that precipitates in a sewage system tank.

solid waste -

All solid and semisolid wastes, including garbage, rubbish, ashes, industrial wastes, swill, demolition and construction wastes, and household discards such as appliances, furniture, and equipment. This curriculum deals primarily with the solid waste generated by households and schools.

solid waste management -

The controlling, handling, and disposal of all refuse. The goal of this solid waste management curriculum is to reduce waste to a minimum through the "4R's" of reduction: revise, reuse, recycle, recover.

source separation -

The sorting out of recyclable materials at home and in school.

thermodynamics -

The science concerned with the relations between heat and mechanical energy or work, and the conversion of one into the other.

transfer station -

An intermediate collection facility temporarily holding solid waste en route to the landfill.

unsecured load -

Any material liable to fall or blow from a moving vehicle and become a hazard, litter, or debris, on a roadway.

A-WAY WITH WASTE

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For more information:

Mr. David Galvin
Project Manager, Metro
821 - 2nd Ave.
Seattle, WA 98104 (206) 447-5885

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Washington Department of Ecology
Litter Control and Recycling School Program Representatives

Jan Lingenfelter
School Program Coordinator

Todd Peterson
Education Specialist

Washington State Department of Ecology
4350 - 150th Ave. N.E.
Redmond, Washington 98052
(206) 885-1900
SCAN 8-731-1111

Dennis Johnson
Department of Ecology
N.W. Regional Office
4350 - 150th Ave. N.E.
Redmond, Washington 98052
(206) 885-1900
SCAN 8-731-1111

(Counties - King, Snohomish, Skagit, Whatcom, Kitsap, Island, San Juan)

Art Hugo
Department of Ecology
S.W. Regional Office
7272 Cleanwater Lane
Olympia, Washington 98504
(206) 754-1741
SCAN 8-235-1741

(Counties - Clallam, Clark, Cowlitz, Grays, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum)

Leslie Getchell
Department of Ecology
Eastern Regional Office
N. 4601 Monroe, Suite 100
Spokane, Washington 99205
(509) 456-2926
SCAN 8-545-2926

(Counties - Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman)

Gary Weston
Department of Ecology
Central Regional Office
3601 West Washington
Yakima, Washington 98903
(509) 575-2491
SCAN 8-558-2491

(Counties - Okanogan, Chelan, Douglas, Kittitas, Yakima, Benton, Klickitat)

Alice Adams
toll free Hotlines
1-800 Recycle
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Department of Ecology
Headquarters
Mail Stop PV-11
Olympia, Washington 98504

RESOURCES AVAILABLE FROM THESE REPRESENTATIVES ARE LISTED ON THE NEXT PAGE.

WASHINGTON DEPARTMENT OF ECOLOGY RESOURCES

Order from the Regional Office serving your county. See page 343.

AUDIO-VISUAL MATERIAL AVAILABLE ON LOAN

MOVIES - 16mm

Garbage. Educational Media, 1969, 10 min. color.

See activities:

Litter is Waste Out of Place, p. 27
Nowhere is Away or Where Is There Space for Waste, p. 31
Why Bury Waste?, p. 68
2001: Trash Odyssey, p. 146
Garbage: Its Possibilities!, p. 161
Disneyland It Ain't, p. 247

Go. Dowling - Shepard Productions, 1979, 10 min. color.

See activities:

What's in a Cycle?, p. 222
Take-Home Recycling Kit, p. 229

Home. Radio and TV Commission of the Southern Baptist Convention, 1972, 20 min., color.

See activity:

Waste, Then and Now, p. 92

The Litterbug. Walt Disney Productions, 1955, 10 min., color.

See activities:

Litter is Waste Out of Place, p. 27
Litter, Litter Everywhere, p. 45
Nurture Some Nature, p. 52

Toast. Earth Chronicles, 1974, 12 min., color.

See activity:

What Does It Cost for a Piece of Toast?, p. 164

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FILM STRIPS/CASSETTE TAPES

Closing the Loop. California Solid Waste Management Board, 1980, 10 min., color.

See activities:

Disneyland It Ain't, p. 247
Closing the Loop, p. 260

Industry Recycles. California Solid Waste Management Board, 1980, 10 min. color.

See activity:

Industry Recycles, p. 262

Life Before Litter. Ohio Department of National Resources, Office of Litter Control, 8 min., color.

See activity:

Be a Garbage Detective, p. 25

Trash Monster. California Solid Waste Management Board, 1980, 12 min., color.

See activities:

Making a Mini Landfill, p. 36
Solid Waste Survey, p. 76
Brainstorming and Landfills, p. 95
Research Into Recycling, p.227
Take-Home Recycling Kit, p. 229
Disneyland It Ain't, p. 247

Waste to Energy. California Solid Waste Management Board, 1980, 10 min., color.

See activities:

The Road to Recovery, p. 297
Waste to Energy, p. 315

Wizard of Waste. California Solid Waste Management Board, 1980, 12 min., color.

See activities:

Litter is Waste Out of Place, p. 27
Nowhere is Away or Where Is There Space For Waste, p. 31
Making a Mini Landfill, p. 36
Biography of a Favorite Thing, p. 207
Recycling is Our Business, Is It Yours?, p. 225
Research Into Recycling, p. 227
Take-Home Recycling Kit, p. 229

VIDEO TAPES

PSA's. Washington State Department of Ecology, public service announcements, VHS 1/2" tape, 3 min., color.

See activities:

Litter, Litter Everywhere, p. 45
Ads Add Up, p. 49
Public Service Announcements - Can You Say It Better, p. 126

SLIDE SHOW

WDOE solid waste slide show
"Recycling in Washington" slide show

See activities:

Why Bury Waste, p. 68
Out of Sight, But Not Out of Mind, p. 70
Solid Waste Survey, p. 76

FREE MATERIALS

BROCHURES

Washington State Department of Ecology. Guide to Household Recycling. Olympia, Wa., 1982.

See activities:

Garbage: Its Possibilities!, p. 161
Some Cans are More "Attractive" Than Others, p. 214
Research Into Recycling, p. 227
Disneyland It Ain't, p. 247

Washington State Department of Ecology. How To Go Recycle!. Olympia, Wa., 1985.

BAGS

Litterbags, three sizes: car, one-cubic-foot, and two-cubic-foot.

See activities:

Litter, Litter Everywhere, p. 45
Nurture Some Nature, p. 52

CERTIFICATE OF AWARD

Model Litter Control & Recycling Program, Certificate of Award. Washington State Department of Ecology, 1983.

See activities:

Take-Home Recycling Kit, p. 229
Logos and Slogans for Recycling, p. 270

POSTER

"The Seven Sources of Litter"

See activity:

Litter is Waste Out of Place, p. 27

MAGNETS

With 1-800-RECYCLE information.

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Some Cans Are More "Attractive" Than Others, p. 214

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ACTIVITY EVALUATION FORM

A-way With Waste
Curriculum Guide

Please return evaluation form(s) to:

Jan Lingenfelter
School Program Coordinator
Washington State Department of Ecology
4350 - 150th Ave. N.E.
Redmond, Washington 98052 (206) 885-1900
SCAN 731-1111

Name: ______________________ School: ____________________

Address: ____

County: ____________ Phone Number: __________ Grade level: _____

Secondary grade subject area(s): ______________________

Title of activity: ____________________________________

Your class's grade level: ________ Subject area: ______________

Number of students: ____________

1. Please rate the effectiveness of this activity as a learning tool.

   Very effective: __________ Effective: ______________
   Somewhat effective: ________ Ineffective: ____________

2. Did the activity's learning procedure lead to the learning outcome? What changes or additions to the learning procedure would you suggest?

3. Is the concept on which the activity is based sufficiently important to justify the attention given it?

4. Is the lesson's stated grade level, in fact, appropriate?

5. Does this lesson sufficiently teach your specific subject as well as solid waste management concepts?

6. Did you make use of the resources or bibliography?
List titles please:

7. Can you recommend other books/materials suitable for this activity?

8. What other changes or corrections would you suggest for this material?
You may wish to xerox activity with improvements and return.

9. If you have not yet attended a Teacher-Trainer workshop introducing the A-way With Waste curriculum and the Washington Department of Ecology's School Programs would you be interested in doing so? Please list names of other interested teachers.